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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Excess Water in Cement Glue

CEMENT, sand and stone without water will not become concrete, but water beyond that necessary to provide the right consistency of glue to hold together the inert materials is a weakening element, not only because it reduces the strength of the glue but because it permits voids. It is only within recent years that the glue strength theory has been studied, but ever-growing tests are indicating its plausibility. Thus, the high-pressure tests reported on another page by Professor Wiskocil were apparently initiated on the void theory. The more water squeezed out of concrete, the closer together the particles would pack, and consequently the higher the strength which would result. Within limits this was proved, but it was also shown that strength did not increase proportionately with density. Evidently, some of the water squeezed out of the concrete was waste material in so far as helping in the development of a maximum strength glue was concerned.

City Transit Developments

STRIKINGLY new aspects of transit improvement in large cities are brought to view by recent developments in Pittsburgh and Cleveland. Both cities are on the way to shelving their plans for rapid transit and taking up instead means for increasing the efficiency of their surface-car systems by facilitating car movement in the congested districts. Pittsburgh, by vote of the people, has just adopted the administration's bond-issue proposal, and thereby decided in favor of building a $6,000,000 underground street-car loop encircling the business district, a project described in *Engineering News-Record* of May 29, 1919, p. 1059. Cleveland has been advised by its consulting engineers on rapid transit to undertake a similar enterprise, different only in detail. These events mark a significant change in thought on transportation problems in large cities, which hitherto has concerned itself with little other than rapid transit. The long-haul possibilities of the existing surface-car systems are evidently attracting attention strongly enough to justify the study of radical schemes for developing them. Much further growth of thought in this direction may be anticipated. But there is another significant point to be realized. Hitherto it has been only dimly appreciated that the study of city transit problems is the municipal engineer's responsibility—and one of his most weighty and most difficult responsibilities. Transportation, the city's life current, is presenting ever more complex problems, and the municipal engineer ultimately must deal with them. Today they are only too generally left unconsidered. Such developments as that at Pittsburgh, however, make it clear that we are approaching a definite realization of the fact that municipal engineering includes transportation.

Street-Car Loop Subways

REMOVAL of street cars from the surface of crowded business districts has many attractive possibilities. Commercial life is nowadays so seriously hampered by street obstruction that when the street cars are removed from the surface large benefits will unquestionably be derived. These benefits, however, have not yet been explored by study or determined by experience. The subject is in effect brand new; Boston and Philadelphia can hardly claim to furnish adequate data. Outside of the consequential benefits, however, street-car subways hold out little promise of producing cash returns. There will, no doubt, be a large traffic increase when the cars can move freely instead of having to pierce the downtown traffic blockade, which will mean increased revenue. But on the other side of the ledger is a very great first-cost item—six millions for Pittsburgh, fifteen millions for Cleveland. And this must be charged wholly to street-car operation, for it is idle to expect that the subway loop will later on be taken away from the street-car system and given over to rapid transit. It will remain a permanent item of the street-car plant. The investment is so large, moreover, that it is sure to delay rapid-transit construction by some years. It is therefore of primary importance that the costly loop projects should be worked out on sound engineering principles; otherwise they may easily bring disappointment. Capacity and traffic distribution are matters needing specially careful study. Unless the traffic capacity is increased and unless concentration of traffic is reduced, the full benefit of the system cannot be obtained. It remains to be seen whether the plan of turning a dozen or more lines into two terminal tracks, as the Pittsburgh project contemplates, will allow the radiating car lines to develop maximum capacity. The Cleveland project, which we hope to be able to describe next week, is interestingly different in its terminal characteristics. On the other hand, distribution of traffic as secured by the Pittsburgh ring-main of transit is sure to prove advantageous. Downtown centralization is an ever-present evil in the growing city.

Engineers Should Study Legislative Bills

THAT engineers need to consider the wording as well as the general purpose of legislative bills which affect them or their work, is indicated by an incident connected with the bill recently passed by the Illinois legislature for the proposed deep waterway from the Chicago Drainage Canal to the Illinois River, which is estimated to cost some $20,000,000. As drafted, the bill provided that proposals for all contracts over $5000 and proposals for the lease of water power should be advertised "for at least four weeks in a daily newspaper printed in the City of Chicago and in such other publica-

tions as may be deemed proper." Whether this was due to lack of understanding or to the unenlightened policy of trying to limit the work to local bidders is not evident. In the bill as amended in the house and now signed by the Governor this clause relating to the publication of notices of proposals provides as follows: "Notices shall be previously published at least once a week for four weeks in two daily newspapers printed in the City of Chicago and in two engineering and contracting journals of general circulation in the United States and in such other publications as may be deemed proper." Whoever proposed and secured this important change did good work in the interest of the State of Illinois as well as in that of the engineering construction industry.

The Tale of a Bypass

"FOR want of a horseshoe nail" might well be paraphrased as follows: But for a bypass filter valve many a mother in Moline, Ill., might still be supported in comfort by her son taken by typhoid.

A chain of circumstances is usually responsible for a sudden single outbreak of typhoid, but modern sanitary science has so well educated those placed to control these circumstances that the germ has little chance of getting to its victim past all the sentinels. In the first place, physicians and nurses are supposed to sterilize or burn all dejecta. Then, in many cases, sewage is treated before discharge into water courses, and, once it is discharged, the dilution is so great that the separate bacteria die out in an untoward environment. Most water-works intakes are located far enough away from sewer outlets to permit this action to take place. Once inside the modern water-works system, the life of a germ is constantly jeopardized by long-time settling, coagulant entanglers, efficient filters, and finally, a death-dealing dose of chlorine. Even then, in case of an emergency break-through, citizens contribute one last hurdle in the way of boiling.

Moline typhoid germs seem to have been plentiful and of a particularly hardy nature. In addition, as explained on page 1264 of our issue of June 26, 1919, the pathway along the whole typhoid route seemed to have been mercifully easy for the germ.

It is reported that lawsuits have been started in Moline to recover damages, but the fact that citizens have not, long ago, smashed out the particular bypass valve which admits the germs to the water system testifies to the forbearance or indifference of an apparently normal, well informed Middle West city.

Railway-Tie Preservation

PRESERVATIVE treatment of track ties is no longer an experiment. Its important relation to track maintenance and to timber conservation has been proved; yet the use of treated ties increases too slowly. Inertia and doubt on the part of railway purchasing and executive officials, lack of uniform care on the part of the manufacturer, and lack of understanding between the two parties, contribute to this result. The lack of mutual understanding is so prominent as to affect even cases where manufacture and consumption are closely related, as in a railway's own tie-preserving plant.

Occasional unsatisfactory results of tie treatment form no adequate reason for d[illegible]ying its advantages. They may be traced usually to carelessness in selection or handling of the ties. Good results cannot be expected where the preservative is applied to ties already rotting, where good ties awaiting treatment are stacked in such a way as to invite incipient rot, or where the impregnation is not adequate. But when ties are selected, stored, seasoned and treated properly they will always give efficient and economic service.

In tie preservation as in other matters, satisfactory experience is apt to get less notice than unsatisfactory. But there is no dearth of facts as to the success of tie treatment. Thus, one railway, with a large supply of tie timber that will give a life of only three to five years, found from advance calculations that treatment which would increase the life to eight years—the life of the untreated ties of better kinds of timber—would be economical. As a matter of fact, these treated ties promise to average 18 years' life. Again, a treated tie recently exhibited has been in main track on a French railway for 47 years and is still sound; and this one tie represents many thousands of similar ties. The larger European countries have, in fact, accumulated so much favorable experience that the use of treated ties is regarded as no more an experiment than that of steel rails or steel bridges.

War conditions have affected the tie-treating industry severely and have dislocated the programs of railway maintenance. With the more favorable conditions now opening, however, there is an opportunity to consider economies rather than emergencies. Preservative treatment of ties promises economy, reduction in track work, and improved track condition due to less frequent disturbance for tie renewals, besides conserving the timber resources of the country. These are strong arguments for a much wider use of preservative processes—and perhaps for more care in their application.

A Movement Without Definite Purpose

WISE prudence was displayed by the authorities of the American Society for Testing Materials when they decided, at the recent Atlantic City meeting, to defer action on the reorganization proposal of the Engineering Standards Committee. The committee would reorganize by making itself independent of the societies that founded it; setting up as an association, no longer under the control of the societies but standing above them and controlling work that they originated and fostered. For the American Society for Testing Materials this means virtually complete subordination, since all its essential work is the making of standard quality specifications. The society, in other words, is asked to become a subordinate committee; as the Standards Committee itself has described it, the proposed association would occupy the same relation to the societies as these now occupy toward their technical committees. Wisely, therefore, the society postponed action and concluded to take up the question in conference with the other societies.

Though the five societies are not at present equally concerned in the issue, they will unquestionably reach a sound final decision. The Mechanical and the Electrical Engineers have developed standardization and normalization in fundamentally important manner; the Civil Engineers and the Mining Engineers have done but little in this field. It would not be unnatural, then, were the latter societies to regard the question with in-

difference, since their present work would be but slightly affected. In principle, however, the issue is vital for all the engineering societies: Shall they subordinate themselves to an outside organization with respect to some of their best work?

Serious consideration is also invited by the conditions that led up to the reorganization proposal. The authorities of the American Society for Testing Materials were impressed with the fact that the committee appears to have made no sincere endeavor to carry out its original instructions, and this, no doubt, formed the basis for their disapproving statement that the proposed reorganization "is not looked upon with favor at this time." The statement gives a hint that the Standards Committee failed to consider the situation in which it placed itself and the societies, that it misappreciated the psychology of the relation. Formed by five engineering societies only last October, under specific instructions from and responsibility to these societies, the committee now, after very few months, comes before the societies without any showing of work done, without any evidence of having tried to carry out its mandate, and asks for wider authority and less responsibility—in fact, unlimited authority and complete abrogation of responsibility. This is not a course of action to command confidence.

Actually, the case is even a little worse. The original constitution of the committee was drawn virtually by the leading men of the committee itself, as they also were leaders in the organizing committee that developed the entire project. Nearly two years were spent in working out the form of organization; yet hardly had the societies given their approval and the committee been organized when it lost faith in its own constitution and undertook to start over again on a radically altered basis. Obviously, stability of purpose, that indispensable ingredient, was lacking. A great national movement was attempting to get under way lacking the backbone of stable purpose.

Has any definite purpose been exhibited by the committee at any time? Its actions must supply the answer: They consistently evidence lack of aim, of objective. From its first days the committee has gone no farther than to say that it would deal with "engineering standards"—a term that means many things to many men. Had the committee been animated by a vital, forceful conception of its mission and its field of work, we may be sure that that conception would have impressed itself on the organic document of the whole movement, the constitution. Definite purpose would have inspired the committee, when it took up active work, to institute a survey of its field and map out its course. But this, too, was not done.

There was no purpose, no definite objective, to guide the committee itself last January, when another group of men met in Washington to plan for writing advisory rules on fire protection and safety of elevators and ladders, industrial protection, and perhaps building ordinances. No one knew whether the term "engineering standards" was elastic enough to stretch over this field. The decision was reached to absorb the Safety Code Conference, by reorganizing the committee; yet not a word concerning this is to be found either in the new constitution or in the statement and argument presented in support of the reorganization proposal, nor is there any certainty that the important safety code work will, if the reorganization goes through, be carried on, or whether it will be allowed to die. Lack of aim has been the dominant characteristic throughout.

Clearly, some purposeful planning must be done if the right end is to be attained. There is need, too, for thinking of the broadly coöperative nature of the standardization project. Information concerning the object, scope, and proposed means must be spread widely if the support of engineers throughout the country is to be obtained. No such educational process has been carried on by the committee. It has not sought publicity. It has been rather resentful of public discussion. Much must be done, and much must be undone, if the profession is to join actively in the work of either committee or association—as the societies may decide.

Because engineers have had no opportunity to become familiar with the standardization movement, the numerous desires for centralized action of one kind or another toward the preparation of uniform rules have remained formless, and have not been weighed or coördinated. Unfortunately, many of them are narrow in interest and clearly not suited for national action; their proponents, however, rightly seeking the advantage of most authoritative decree, are hopeful that they may be able to back their purposes with the strength of all the national engineering societies, through a joint standardizing body. The situation is large in its good and evil possibilities. Purposeful clearness of thought will do much toward sifting out and coördinating the many heterogeneous notions now afloat. On the governing boards of the societies now rests the burden of bringing about this result, primarily by outlining the vital objects and limits of central standardization.

We have said that "engineering standards" means many things to many men. Few words, indeed, are so popular or so loosely used. Engineers talk of standard highway signs and pavement crowns, standard bridge loadings and details, standard car couplers, airbrakes, and pullman cars; standard fireproof construction, I-beams, screw threads, and wire splices; standard inches and standard frequencies, standard aëro engines, ships and life preservers. The word is applied in miscellaneous variety of meanings to boilers, bushels, and building ordinances, to train order codes, trolley wheels, and shovels, to catchbasins, auto parts, door sizes, and pipe taps; it is applied to time, to thermometers, to fire hose, and sometimes even to coal sizes, water purity, milkfat percentages, and college curricula. And President Clamer recently suggested that factory cost-keeping systems might be included in "engineering standards." Equally inchoate are the purposes animating different men in discussing standardization; among them are commercial convenience, interchange, foreign trade, safety, legislative uniformity, and broad ideas of internationalism. Which are purposes that may properly be the basis for action by engineering societies? What kinds of products, processes and rules are proper subjects for "engineering standards"?

It may be possible to crystallize a sound program of action out of the existing infinite mass of vague possibilities. Could the committee have applied its varied abilities to a broad-gage study, a sorting and coördinating from which such a program would have emerged, one proper for technical societies to carry out, it might have done the country and the engineering profession a service of lasting value. But because of the committee's fundamental lack of purpose, that work remains to be done by the societies.

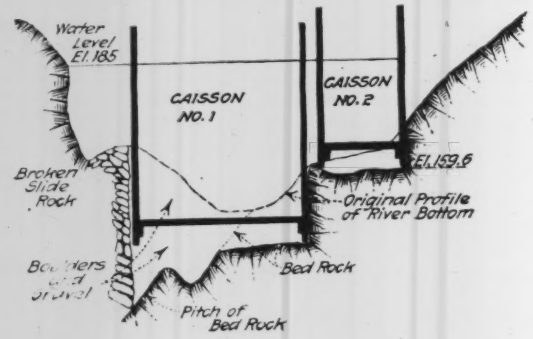
Dam Foundation Placed by Suspended Pneumatic Caissons

Difficult Problem in Getting in Footing in Deep and Swift Water in Narrow Gorge at Lowest Part of Canadian Dam—Caissons Sunk in Rock Formation

CONCRETE pneumatic caissons were used in making the closure of the Spanish River at High Falls, in northern Ontario, in the foundation of the new concrete dam being built there for the International Nickel Company.

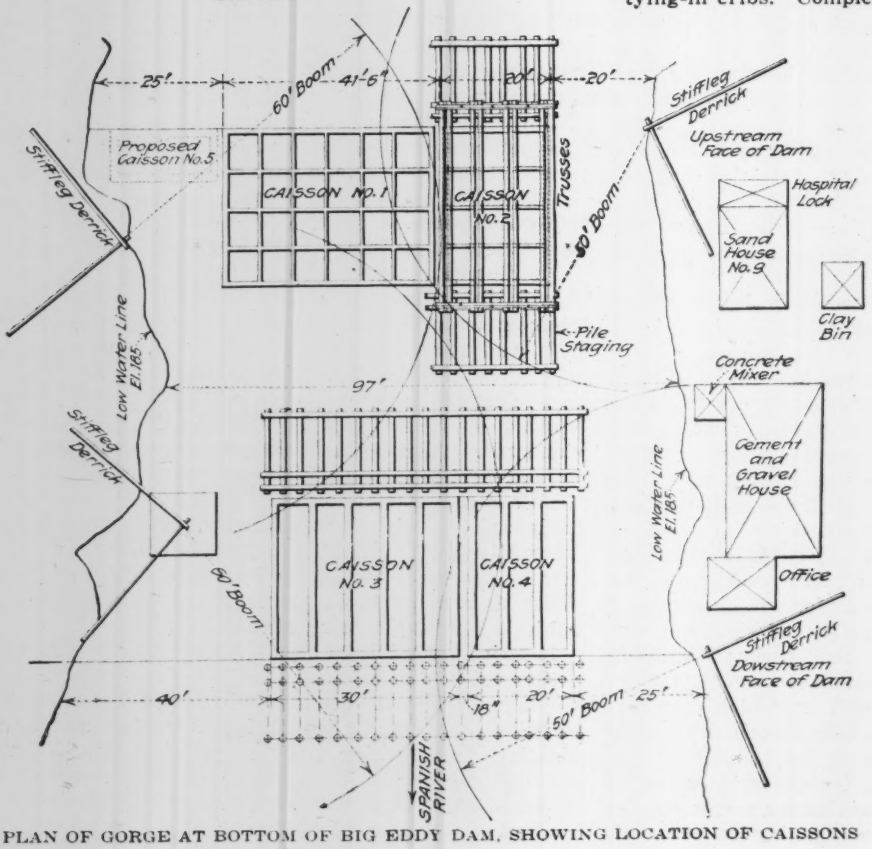
Furthermore, because of the difficulties found in launching and the use of a concrete working chamber, the caissons were built in place suspended from temporary trusses and were lowered to the rock through which they were then sunk. The work was all carried on through the severities of a Canadian winter, in a district that is well isolated from the centers of population.

The structure, which is known as the Big Eddy dam, is to provide storage in connection with an existing power plant which supplies current to the company's plant at Copper Cliff, Ont., 25 miles distant. The project in general besides the dam includes clearing the flooded area, which consists of approximately 6000 acres extending 20 miles north of the dam. The dam itself is a gravity concrete section about 1000 ft. long, 100 ft. high above the existing water level, and 145 ft. above the river bottom. The river at this location runs normally through a narrow rock gorge, which is only 130 ft. wide and has a normal water depth of about 45 ft. and a maximum depth of 55 ft. During flood stages the flow rises as high as 16,000 sec.-ft., and the minimum flow is 1600 sec.-ft. The only underwater work for the dam was that in the closure of this narrow gorge.



The original scheme of construction contemplated the sinking of two reinforced-concrete caissons at the upstream and the downstream limits of the dam footing, and with these caissons as cofferdams to lay dry the intermediate area and to fill in the footing with concrete.

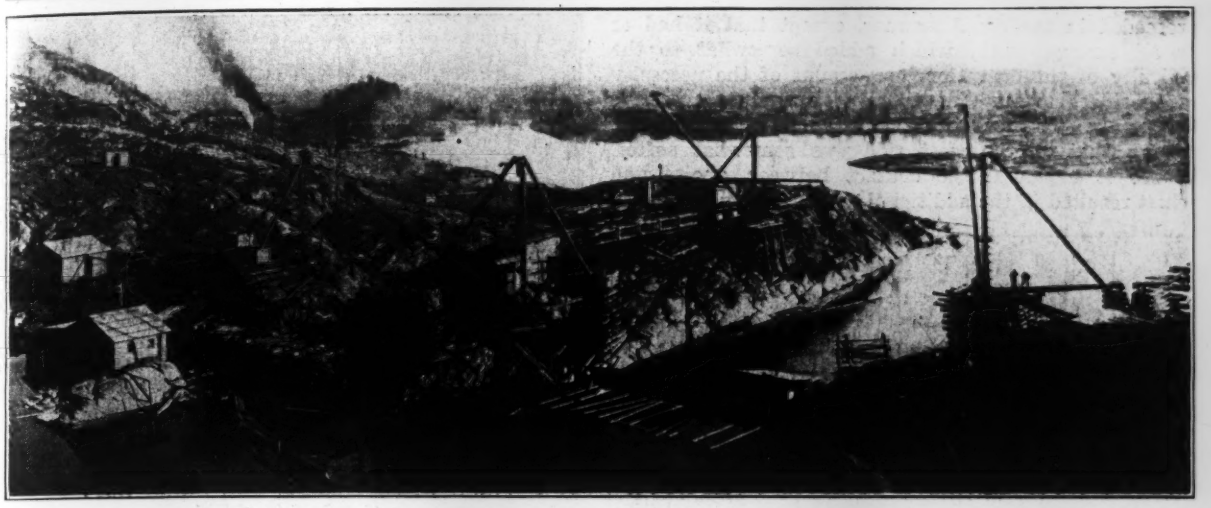
So far this scheme has been carried out as designed, except for the addition of a smaller concrete caisson at one upstream side of the gorge, where a fault in the rock formation was found which required a more complete closure than that which would have been afforded by the cribbing designed to extend from the caissons to the sides of the rock wall. So far the four main caissons have been placed and work is now going on in the construction of the smaller caisson and of the tying-in cribs. Complete closure will be made by driving sheet piling to close up the small openings between the caissons.



PLAN OF GORGE AT BOTTOM OF BIG EDDY DAM, SHOWING LOCATION OF CAISSONS

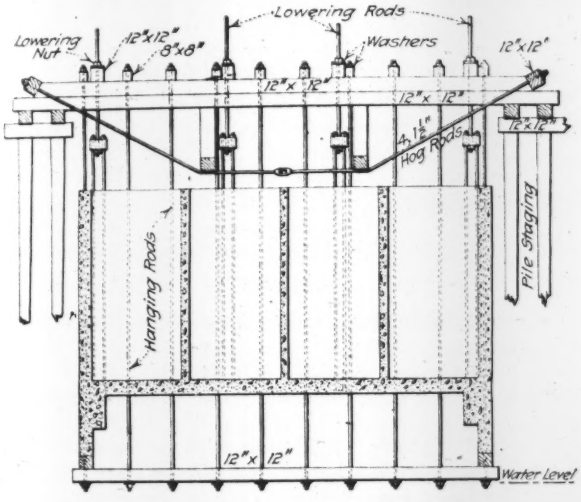
Because the caissons could not be launched, a special method of suspending them had to be devised. This consisted in placing up and downstream of each caisson temporary pile trestle bents, between which timber trusses were built. From these trusses the concrete caissons were hung during their construction, and they were lowered until they reached the rock through which they were driven. The sketch plan of the gorge and the caissons shows all five caissons, but illustrates the timber suspension system for only one, caisson No. 2.

The procedure was as follows: First, a templet giving the correct size of the caisson was made of timber and floated into position. Timber pile bents, six piles to each bent, were then framed on shore for their full height after soundings had been taken to determine that



GORGE ON SPANISH RIVER IN ONTARIO WHERE PNEUMATIC CAISSONS WERE SUNK FOR DAM FOUNDATION

height, and were swung into place by the derricks seated on the adjacent rock wall. These piles had no penetration, but to make certain that their bearing



METHOD OF SUSPENDING CONCRETE CAISSONS FROM TEMPORARY TIMBER TRUSSES

was good the pile points were packed about on the bottom with concrete in bags placed by divers, and the bents were thoroughly interbraced. The trestles, as noted, were only up and downstream of the caissons and not on the sides. The wooden trusses, as shown in one of the views and in the detail of the suspension system were then seated on the bents to carry the load of the caisson during its erection. Long rods, at the bottom of which were fastened wooden timbers, were suspended from these trusses, and on the timbers the cutting edges were placed and located in their proper positions. Concrete forms were then built up, the reinforcement was placed, and the concrete caisson was built as high as clearance permitted. After the concrete had set up, the load was transferred to a set of threaded rods which had been embedded in the roof of the working chamber, and the main suspension rods and the carrying timbers below were removed.

The threaded rods passed through nuts on plates carried on the top chords of the trusses. By the loosening of these nuts the caissons were lowered as required. As they were lowered and the load was reduced on account of the buoyancy of the water, additional heights of the caisson were built up.

Before the caissons were placed, the river bottom, which was very irregular, was roughly leveled off by means of submarine drilling and blasting. As shown in one of the views, this drilling was accomplished with 3½-in. steam drills erected in leads on small floats. The depth of the holes was approximately 20 ft., and as there was about 20 ft. of water where they were working, the steel used was 42 ft. long. The bottom thus blown out was sounded, and if not level enough to seat the caissons uniformly it was further leveled by means

CAISSONS NOS. 1 AND 2 AT UPSTREAM FACE OF DAM FOOTING

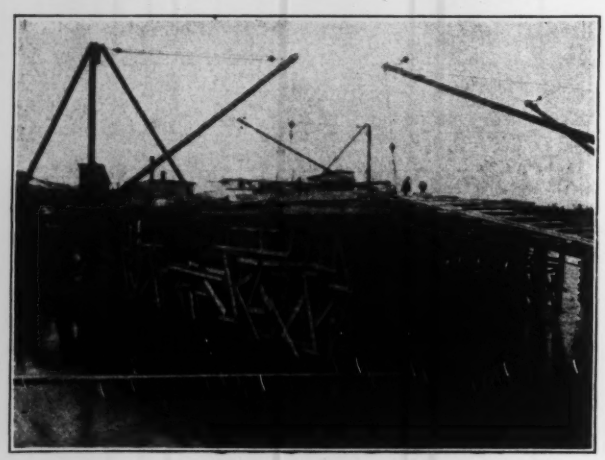
proceeded in the usual manner, except that it had to be all through rock, which added somewhat to the difficulty of the operation, on account of the necessity of considerable mudding to provide against excessive loss of air. The rock in most instances was very hard, though that on the west side was somewhat softer. Where it appeared the contact between gneiss and schist resulted in the additional caisson being sunk. At

TRUSS SUSPENSION FOR REINFORCED-CONCRETE PNEUMATIC CAISSONS

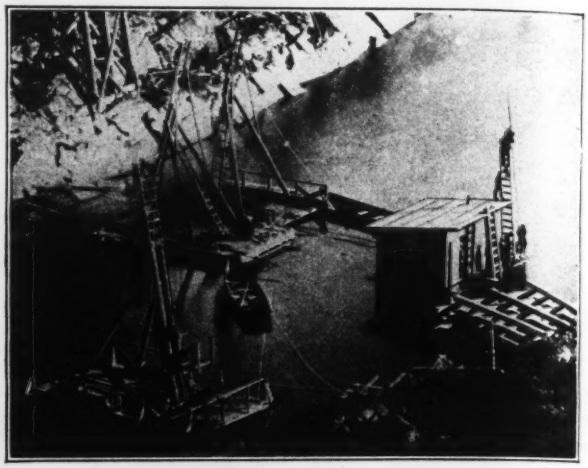
this location concrete bag piers were built up for the cutting edge to rest on and were cut out as the caisson sank in the same manner as was done with the adjacent rock.

The work was carried on through an Ontario winter, which, while somewhat above normal, was very cold for anyone not used to such weather. The contractors were particularly fortunate in that the temperature did not get below —28° F. Frazil ice interfered somewhat with the work, owing to its tendency to lodge on the pile bents and build up a temporary dam. One time such a dam caused the difference of 4 ft. between the upstream and the downstream levels of the water.

Air went onto the caissons Dec. 15, 1918, and was taken off Mar. 17, 1919. During this time considerable care was exercised in protecting the placed concrete



TIMBER TRESTLES FROM WHICH CAISSONS FOR DAM FOUNDATION WERE HUNG



THREE-INCH STEAM DRILLS PREPARING BOTTOM FOR CAISSON SEATING

against cold by means of tarpaulins outside of the caissons and salamanders inside. A fairly elaborate camp and construction equipment layout was provided for the work, although there was not so much of this needed for the part which has been described. A power house for furnishing air to caissons and drills had to be put in, because the nickel company needed all the power it had to take care of its war work in its other plants. The camp accommodated 700 men of all classes of labor, of whom 105 were sandhogs.

All the work is being done by Fraser Brace & Co. contractors, of New York City, for the International Nickel Company.

Tunnel on Pennsylvania Railroad Damaged by Gasoline Fire

A train fire in the Sabula tunnel of the Pennsylvania R.R. on April 30 did serious damage to the tunnel. It resulted from the wrecking of a freight train in which were two tank cars containing 15,000 gal. of gasoline; these were destroyed by the fire. The tunnel is single-track, 1964 ft. long, 26 ft. wide, with semi-circular arch, and is lined with sandstone; it has been in service since 1874. From a report made to the operating department of the railroad, the main facts of the remarkable accident are: An eastbound train was stopped, just after the engine had emerged from the east portal, by a break between the eighth and ninth cars, the ninth car being about 100 ft. inside the tunnel portal at the time. Some distance back of this point a fire was seen in the tunnel, at the location of the gasoline tank cars already referred to. Within 10 or 15 minutes rock could be heard falling from the roof of the tunnel. The rear half of the train was uncoupled by a brakeman and hauled out. The fire burned for 42 hours, and destroyed eight of the 16 cars left in the tunnel. Fire engines from Dubois, Penn., helped in extinguishing the fire by pumping water from a nearby lake. Subsequent examination showed that 155 ft. of the tunnel roof had caved in, covering five cars and completely blocking the tunnel. For a distance of 600 ft. west of here the arch stones were so badly burned that they crumbled easily, and the arch was distorted, sagging as much as 22 inches in places.

Sewer-Construction Records Used at Scarsdale, New York

Daily Record Blank, Rock Book and Sample Headings From Final Estimate Book Used on 22 Miles of Sewers

BY PERRY THOMPSON
Yonkers, N. Y.

FIELD-OFFICE records of sewer construction at Scarsdale, N. Y., were more complete than usual, partly because the field work was begun in January of a severe winter when the instrument men were compelled to stay in on many days. The time thus made available was devoted to a variety of work preparatory to record keeping. This facilitated the work of the resident engineer when the rush of construction was on. Samples of the record, with comments, are here given. The aim was to combine simplicity, accuracy and completeness.

As the work was begun during a period of depression, just before the great war, when labor and material were plentiful and cheap, and was completed during the war, when the opposite condition prevailed, no attempt was made to keep a record of unit costs other than that obtained by averaging with the use of total quantities and total costs.

The well-known unit-cost system, so flexible and specially suited to sewer work with its many uncertainties, was adopted, and although an effort was made to cover every contingency, the system was supplemented by the percentage system for use in case a price agreement could not be reached on work not originally provided for. This gave the engineers and the village an opportunity to order changes, with satisfaction to both parties to the contract and without risk of litigation.

SEWERAGE OF SCARSDALE, N. Y.

DAILY REPORT. DATE March 19 1914

NAME OF SEWER LINE Post Road (South) Br. Butler Line

Size of sewer 8" Size of underdrain none

Trench opened to / from	1+30 / 0+0	130 ft.
Underdrain laid to / from		ft.
Sewer laid to / from	0+60 / 0+0	60 ft.
Iron Pipe to / from		ft.
Trench filled to / from	0+50 / 0+0	50 ft.
Saddle piles to / from		ft.
Platform laid to / from		ft.
Concreted sewer to / from		ft.
Bracing used to / from	1+20 / 0+0	120 ft.
Sheathing left in to / from		ft.
Ledge rock to / from	0+50 / 0+20	30 ft.

Foreman's name

Total hours drilling by hand 16 By power —
other rockmen 16
plugging by hand 8 By power —
other common labor 96

Remarks Soil firm. good bottom. Little water.

LOCATION NOTES

UPPER END OF LEFT	SEWER LINE RIGHT	
3+00	MH #16	
(2) 2+09.4	2+07.4	(2)
(1) 1+64.9	1+62.9	(1)
	1+52.8	L.H.1
1+18.4	1+16.4	
0+59.3	0+57.3	
0+0 LOWER END OF	MH #15 SEWER LINE	

Number of Yds. including those extended 8
" " extensions (1) Pipe 2 (2) 2 (3) —
" " Lamp-holes 1

If yes in T for L.H. Top about 12" feet below surface Concrete laid under and around T. as per detail drawings.

James Lewis Inspector

FIG. 1. DAILY RECORD BLANK OF SEWER CONSTRUCTION
Original on 8 x 11-inch sheets

LEDGE ROCK — BUTLER LINE, 24" — SCHEDULE A

STATION	DEPTH TO SEWER INVERT	AREA INCLUDING 6" BELOW INVERT (FROM TABLE)	MULTIPLE OF MIDWAY AREA (4 TIMES)	FRACTION	CU. FT.	CU YDS	TOTALS	MANHOLES CU YDS (FROM TABLE)	FLUSH TANKS CU YDS (FROM TABLE)
M.H.#2 4+11.6	2.0					*		348	
5	5.2	23.20	8184	122.32×50/6	1023.50	3791			
5+50	4.0	17.78	7464	111.98×22/6	410.59	1521			
5+72	4.4	19.56	7844	147.9×28/6	690.20	2556			
6	6.6	29.90	13356	200.44×50/6	1670.33	6187			
6+50 STEP	8.0	36.98							
6+50	6.2	27.92	10600	139.00×34/6	901.00	3337	1294.53		
6+84 STEP	5.6	25.08							
6+84	2.0	9.38							
7+50	5.2	23.20	6416	96.24×66/6	1064.14	3941			
8	7.8	35.94	11764	176.78×50/6	1473.17	5456			
8+229	6.0	26.98	12552	188.44×22.9/6	719.21	2664			
M.H.#3 8+26.1	6.0	—						840	

*Reducing to yards in each case was found to assist in making up monthly estimates. The reductions are readily checked by use of slide rule

FIG. 2. ROCK BOOK ON SEWER-CONSTRUCTION WORK

The work comprised some 22 miles of sewers. There was much rock excavation, 26½ ft. being the deepest trench. The main contract work extended from March, 1914, to October, 1915, but four contracts for extensions continued the work until December, 1917. Hagar & George, of White Plains, N. Y., were the principal contractors. Waring, Chapman & Farquhar, of New York, were engineers, and the writer was resident engineer.

Some of the winter work already mentioned as preparing the way for record-keeping was: Indexing rate books, profiles (front, center and ends of rolls by reference to letters along tops of same); preparing rock books, final-estimate book, etc., as far as such work could be carried at that time; making index maps on white prints by showing in different colors the locations and numbers of manholes, drop manholes, lamp-holes and flush tanks, and the number of location book or grade book in which any line could be found; preparing grade books and from them lists of cuts for field and office use; numbering pages of record-books for manholes, lamp-holes and flush tanks (these needed no indexing because the page numbers corresponded with the manhole numbers, etc.); preparing cross-sectional area tables for rock in trenches accommodating different-sized sewers at depths from 0 to 26 ft. or more, with an increase of 0.1 ft. and a slope corresponding to the specifications, allowing 6 in. below sewer invert; preparing quantity tables for rock in manhole (plain and drop, with amounts to be added in case an underdrain ran beneath) and flush-tanks; preparing a table of quantities of concrete to be laid around pipes in standard and special sections per foot of sewer; making lists of manholes, drop-manholes, lamp-holes and flush-tanks, with their numbers; making a list of sizes, amounts and locations of iron pipe needed; preparing a list of schedules according to street names and private property lines (sometimes two schedules to one street if long, especially if there were two sizes of sewer); placing headings in rock book (Fig. 2) allowing eight lines per 100 ft. of sewer; and placing headings in final-estimate book (Fig. 3), allowing plenty of space for indeterminate quantities.

The list of cuts was taken from the last column of each page of the grade books; it was made in duplicate and proved to be one of the most useful things made during time which would otherwise have been lost. The carbon copy was of great assistance to inspectors and foremen, the former in making out their daily reports (Fig. 1), while the original copy was used in the office for determining quantities of various classes of work, recording extras and checking up and making monthly estimates. It was specially useful when an estimate of cost of completion of work was desired or when the leveler had the grade-books in the field. But the list of cuts was not allowed to take the place of the grade-books, which were carefully watched for changes made in the field.

The engineer visited each trench daily and collected the reports, which were taken to the field office. The various regular and extra items, excepting ledge rock, were entered under appropriate headings on yellow pad sheets which were found to save time and confusion due to rehandling the daily reports. As each item was recorded it was checked off on the report, and the report was then handed to the draftsman, who plotted the Y-branches, lamp-holes, manholes, etc., checked off the report and filed it away under its schedule. When a stretch between two manholes was completed, the totals were transferred from the yellow pad sheets to the final estimate book, and they were checked off on the pad sheets.

In the case of Y-branches, etc., these totals were compared with the plotting of the work as constructed. The main items, consisting of the various classes of sewer completed, were taken from the list of cuts and checked by the grade-books when in the office.

For extra work, extra orders were issued to the contractors, and were on printed forms arranged to give two carbon copies and numbered. One copy was retained by the engineer, and the other was furnished to the sewer commissioners.

Levels on ledge rock were taken by the leveler at every change of direction of its surface. Where the surface was uniform, the stations were taken at some multiple of 6 ft. (averaging 18 ft.) to facilitate the use of the prismoidal formula in calculating its volume. The notes were kept in numbered and indexed level books, and were checked off as plotted on the sewer profile, where the rock surface was shown in brown to distinguish it from the street surface in black and the sewer invert line in red. In some cases, where uniform, the rock surface was averaged by a fine pencil line on the profile, but in most cases all the stations and cuts were entered in the rock book (Fig. 2), where the areas of cross-sections were taken from a table previously prepared, as described above. As each section was transferred it was checked off in pencil on the profile.

As soon as a stretch of work between two manholes or at a manhole or flush-tank was excavated, the total quantity of rock was entered in the final-estimate book and checked off in the rock book. All rock calculations—and, in fact, every calculation—was checked by an assistant who used his initial as a check mark.

The daily records of manholes, flush-tanks, etc., were kept in small notebooks which were carried by the engineer because such construction work was frequently located at great distances from the inspectors, who had no means of transportation. When a manhole or flush-tank was finished it was entered in the final-estimate book and checked off in the notebook.

Monthly estimates of the value of work completed, on which part payments were allowed to the contractors, were started about the end of the third week in each month by getting ready the outline and the headings of the various schedules, some of which were complete and could be entered and closed; others could be partly included with safety. This permitted issuing the estimates promptly on the first of each month. As each item was transferred from the final-estimate book to a monthly estimate it was checked off by means of a small circle placed just before the amount in the final-estimate book. Each monthly estimate was a complete account of the value of work completed to that date, so that the final estimate was the same in form, and it checked the final-estimate book within a few cents, which discrepancy was due to an accumulation of fractional parts of a cent in the rock account.

24" VIT. SEWER
6 FT. TO 8 FT. DEEP, INCLUDING 8 FT.

1914		LOCATION	SCHEDULE	FEET	PRICE	AMOUNT
April	7	Between MH #4 & MH #5 (Butler Line)	A	200.0	$2.03	$406.00*
"		" " "	"	"	"	"

*This sign indicates that the item has been included in the monthly estimate

Y-BRANCHES ON 24" PIPE

1914		LOCATION	SCHEDULE	NUMBER	PRICE	AMOUNT
April	8	Between MH #4 & MH #5 (Butler Line)	A	6	$4.00	$24.00*
"		" " "	"	"	"	"

MANHOLES 6 FT. TO 8 FT.

1914	NUMBER OF M.H.	LOCATION	SCHEDULE	PRICE	AMOUNT
April 10	5	Butler Line, Angle, Between Butler & Ledge roads	A	$10.00	$50.00*
"				"	

MANHOLE DEPTHS EXCEEDING 8 FT.

1914	NUMBER OF M.H.	LOCATION	SCHEDULE	FEET	PRICE	AMOUNT
	91	Beach Lane, North of Hickory Lane	K	4.3	$3.00	$12.90*

ROCK IN SEWER TRENCH

1914		LOCATION	SCHEDULE	CU. YDS.	PRICE	AMOUNT
May 3		Between MH #47 & Junction of Ledge & Ledge Road	C	51.41	$2.15	$110.93*
"		" " "	"	"	"	"

ROCK IN MANHOLE EXCAVATION

1914	STATION	NUMBER OF M.H.	LOCATION	SCHEDULE	CU. YDS.	PRICE	AMOUNT
	0+0	191	From manhole and Walnut Parkway (Boulder 2.0, Ledge 12.0)	F	14.04	$2.15	$30.20*
					"		

CONTINGENT EXTRAS
STANDARD—A—SECTION
CONCRETE FOR SEWERS

LENGTH	SIZE OF SEWER	EXTRA ORDER NUMBER	LOCATION	SCHEDULE	CU. YDS.	PRICE	AMOUNT
273.5	24	3	Between MH #28 MH #3, 5+49.6 & 8+23.4 (Butler Line)	A	31.02	$8.00	$248.16*
			" " "	"	"	"	"

CONTINGENT EXTRAS
—C—
SHEETING & SHORING

1914	EXTRA ORDER NUMBER	LOCATION	SCHEDULE	BOARD FT.	PRICE	AMOUNT
May 16	8	Between MH #35 & MH #36 (Higham Road)	P	1140.	$35.00	$39.90*

FIG. 3. SAMPLE HEADINGS FROM FINAL ESTIMATE BOOK, SEWER-CONSTRUCTION WORK

Concrete Pipe Fails From Unequal Expansion of Shell

Longitudinal Cracks in Unreinforced Pipe Conduit Seem To Be Due to Differential Movement Because of Partial Wetness

By G. E. P. Smith
Professor of Irrigation Engineering, University of Arizona
Tucson, Ariz.

FAILURE of a plain concrete pipe line in the arid country near Tucson, Ariz., was unexplainable except by some new theory of pipe failure. It has been decided that the characteristic longitudinal cracking of the failure was due to differential expansion of the shell of the pipe.

On account of the lack of scientific control in concrete pipe making in the past, there have been many failures of pipe lines. The most usual failure has been that due to crushing as a result of the weight of the backfill. Quite recently investigations have been made to determine the downward pressure of earth filling under various conditions, and a rational formula has been developed. It is expected that external-pressure testing machines for cement pipe will be established at each pipe factory, and that in the future pipe will be so designed that failures will become rare.

The design for internal pressure is simple, and pipe tests for resistance to internal pressure are not difficult to make. There have been few failures from this cause, and those only where hand-tamped pipe has been subjected to rather high heads. Improper design of pipe lines has been the cause of some failures due to water-hammer, especially where air has been trapped, in some instances the pipe being torn apart and thrown out of the trench. Unequal settlement and contraction soon after the pipe has been laid, usually the first night, have caused contraction cracks, which, however, are not considered serious and are quickly repaired.

The new type of failure recently occurred on a long main supply line near Tucson. This line is part of a large contract which had been under construction for some time. The pipe was made on a McCracken packer-head machine, and is exceptionally strong and dense. The main supply line is 20 in. in diameter. The failures have been by long, longitudinal cracks, usually at top and bottom. A view of a cracked pipe is shown herewith. Usually the cracks occurred soon after water was turned into the line, but in some instances cracks occurred where it was thought that no water had been admitted, although the soil was wetted from rain. As soon as the line was repaired and cured, and water was admitted, another crack would occur in some other part of the line, so that for two months the line could not be used. A crop that had been planted was lost, and the water-supply remained idle.

There seemed to be no assignable cause for these cracks. The hydraulic pressure was light. The depth of backfill in one instance was only 6 in., and the design was such that no air could be entrapped.

These failures were accompanied by the destruction of gate pits and division boxes also. A drawing which shows the cracks on the four sides of one of the gate pits is shown herewith. The nature of these cracks, and the measurements that were taken, show that the destruction of the gate pits was caused by the longitudinal thrust of the pipe lines. The expansion of the pipe lines could not have been due to change of temperature, but was due to change in moisture content. The 20-in. pipe was made during the summer of 1917, and was stored in the stock yard for several months prior to the laying. It was subjected, therefore, to the hot sunlight and the drying winds of a semi-arid climate. The expansion due to saturation after the pipe line was laid was sufficient to destroy the 4-in. concrete walls of the gate pits. Lines of pipe smaller than 20 in. in diameter, although subjected to drying out in the stock yard, did not fail by longitudinal cracks, but they did thrust themselves into the gate pits

But how could longitudinal pressure cause longitudinal cracks? This was the difficult problem. It so happened that the first break occurred at a point where

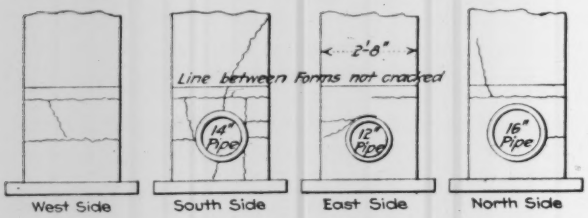
CONCRETE PIPE LINE CRACKED LONGITUDINALLY THOUGH EACH PIPE WAS WELL MADE

Through break was made by sledge in study of failure

the pipe line bends in a gentle curve of about 30°. It was thought possible that the failure was due to longitudinal shear, analogous to what is called horizontal shear in beams. Consequently, an analysis was made to show the relation between the longitudinal compression and the resultant longitudinal shear for any given deflection from a straight line. Assuming the most reasonable constants, the analysis showed that, while the longitudinal shear on a bend may be greater than the resistance to shear of 1:3 mortar, yet the deflection from a straight line due to the failure of pipe layers to maintain accurate alignment alone would not cause destructive shear, although it would produce stresses which at

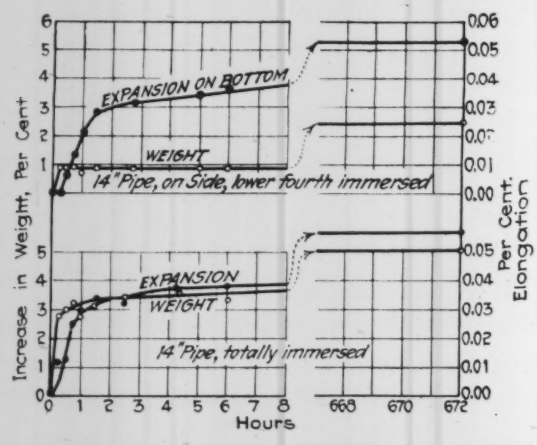
the crown are additive to the tension due to hydraulic pressure and weight of earth filling.

Some laboratory tests were made on specimens of the McCracken pipe which were known to be thoroughly dry. Two of these tests are reported in the accompanying diagram. The two pipes were provided with metal disks 20 in. apart, so that the expansion could be



CRACKS ON FOUR SIDES OF GATE PIT DESTROYED BY EXPANSION OF CONCRETE PIPE LINE

accurately taken with an extensometer. The pipes were carefully weighed. One of them was totally immersed in water, and the other was laid on its side so that only the lower quarter of the center line of the shell was immersed. The diagram gives the absorption-time and expansion-time curves. It appears that the absorption of water is very prompt, but that the expansion lags considerably behind. If the absorption were wholly from the inside, it would be much slower under the same head, because of the dense internal skin made by the revolving packer-head. During the test the pipe that was quarter submerged developed a crack 5 in. long on the inside at the crown. This crack came at the tongue end, which is the densest part of the whole tile, as shown by the slow creeping upward of water by capillarity. While in two months the water had crept upward about 5 in. in the center of the tile, it had during the same period of time crept upward in the tongue less than 1 in. The expansion was about 0.00056 of the length. The "flow" of the concrete could not relieve the resulting stresses.



PARTLY WET PIPE EXPANDS DIFFERENTLY FROM ONE FULLY WET

Some tests on cross-expansion were made also, using a broken pipe from the internal-pressure testing machine. During the early part of the test the crack closed as though the pipe were a compound spring; but after the moisture penetrated beyond the center the crack reopened.

Assuming the initial run of water in a pipe line to fill the pipe partially, then the cross-expansion of the invert, together with the fact that the upper part does not become wetted by capillarity, must develop a bending moment at the crown, and a crack may open on the inside.

While tests were being made in the internal-pressure machine, some peculiar breaks occurred. Pipe that to all appearances should have withstood the full city pressure broke at from 5 to 15 lb. It was discovered that the breaking pressure was greatly reduced by making a test for percolation just prior to making the internal-pressure test. When one of these pipes that had failed at a very low pressure was broken open, it was found that the water from the interior had penetrated about one-fourth of the thickness of the pipe. The following explanation is offered: The expansion of the inner quarter of the shell creates a tension in the outer three-fourths, which may cause failure in the outer portion which still remains dry; this failure permits full expansion of the inner one-fourth along the line of the crack, and the inner fourth then becomes unable to stand the low hydraulic pressure. Similar failures may occur in a concrete pipe line.

The expansion of the inner portion of the shell and the expansion of the invert were the principal factors in causing the failures shown in the view. The tension in the crown, due to several causes combined, exceeded the tensile resistance of the mortar.

Another factor involved is that the normal strength of the pipe doubtless is reduced by wetting, as was shown by Van Ornum several years ago. Pipe of the same quality as that shown in the view were tested for external pressure. In one series of tests, pipe taken from the stock yard at the age of 28 days had an average strength of 2624 lb. per lineal foot, while similar pipe after immersion in water for five hours broke at 1790 lb. per lineal foot.

The mortar used in making the Arizona pipe was a brand which has a high-magnesia content, and it is believed that a high-magnesia cement has a high rate of change in volume with change in moisture content. Tests made by the United States Bureau of Standards indicate this quite clearly.

There was, therefore, a combination of unfavorable condition: A large pipe, high-magnesia cement, a rich mixture, long period in the stock yard, and an arid climate. If any one of these conditions had been absent, the failures would not have occurred. The remedies to be applied in cases where the pipe to be laid are of large size and may have become bone-dry are: Expansion joints in the vicinity of the pipe-line structures, and, preferably, passing the pipe through a dipping process before laying, at such a rate that each pipe will be in the vat not less than 1½ or 2 hours. In the case of small pipes the dipping may not be necessary, but it is desirable to run the water through the line promptly after laying, and to flood the ditch by leaving the valves off at the risers.

A trip was made through California in a search for similar failures. None was found in southern California, and this is due to the fact that none of the pipe makers carried any stock. Moreover, the climate is very much mitigated by the fog, usually the high fog or vela cloud. In the San Joaquin Valley, however, numerous failures similar to those in Tucson have occurred, although the true cause has never been ascer-

tained. The climate of the San Joaquin Valley is similar to that of southern Arizona.

It has just come to the writer's attention that in the building of eight miles of 30-in. reinforced pipe a few years ago many scores of pipe were lost in the pipe yard or along the side of the trench through the opening of longitudinal cracks. These failures may have been caused by the rapid drying of the pipe, the reverse of the failures by wetting noted above.

It is believed that this type of failure—that is, by differential expansion or contraction in a concrete shell or wall—may occur in other lines of construction, such as concrete pavements and certain portions of concrete bridges and buildings. Such failures may be restricted to western America and to other parts of the world where arid conditions prevail for at least a part of the year.

Concrete pipe lines are of the greatest importance to agriculture in the West. Were it not for some form of conduit that is impervious but of low cost, the irrigated area in southern California would be reduced nearly one-half.

Easily Memorized Method for Finding Safe Beam Loads

By Manton E. Hibbs
Structural Engineer, Bureau of Building Inspection, Philadelphia

IN THESE days of slide rules, adding machines and handbooks, much of the so-called drudgery of engineering has been eliminated, although with this elimination has come a certain lessening of skill, and engineers are now to be found who cannot multiply unless the slide rule is in their vest pocket. The following scheme was worked out by the writer when time was so valuable as to preclude even the opening of a beam book. The original intention was to give a quick and accurate method to check up a number of beams uniformly loaded, but its application has been so useful in many ways that it may be of value to other engineers.

A table of standard steel I-beams, reproduced herewith, was made, with depths printed in bold-face type.

SECTION MODULI OF STANDARD I-BEAMS

Depth In.	Weight per Ft. Lb.	Section Modulus, In.³	Factor	Approximate Section Modulus
6	12.25	7.3	1.25	7.5
7	15	10.4	1.5	10.5
8	18	14.2	1.75	14
9	21	18.9	2	18
10	25	24.4	2.5	25
12	31.5	36	3	36
15	42	58.9	4	60
18	55	88.4	5	90
20	65	117	6	120

These depths, ranging from 6 to 20 in., were placed in the first column of the table, while in the second and third columns were placed the weight per lineal foot and the section modulus. In the fourth column was placed a factor derived by the writer. This constant multiplied by the corresponding depth gives a theoretical section modulus, placed in the fifth column.

To memorize this table, the key is found in the 12-in. I-beam. The sum of the figures of its height (1 + 2) gives the factor 3, which multiplied by 12 equals 36, the section modulus. Then the constants for 15-in., 18-in., and 20-in. beams, in order, are 4, 5 and 6. When the depth is less than 12 in. the decrease in the constant is ½ until the 9-in. beam is reached, when the factor varies by ¼. Fifteen minutes of this memory course will definitely fix these values so that it will be practically impossible to forget them.

Now consider the formula for a uniformly distributed load W on a beam of length l ft. at a unit stress of 16,000 lb. per square inch.

$$W = \frac{S \times 16{,}000 \times 8}{12 \times l} = \frac{S}{l} \times 10{,}666$$

and substituting 11,000 for 10,666 it is seen that the section modulus divided by the span in feet is a factor to be multiplied by 11,000 to give the load. Loads calculated in this way will vary from the true value only as much as six per cent, and that only in the case of a 20-in. beam, while the others vary less than 5 per cent.

The writer has so often made use of this mentally that he has not used the tables for nearly ten years, and has used it also frequently as a test against a man with a beam book, and beat him to the result. Since it is no longer fashionable to wear detachable cuffs, this scheme might be valuable to candidates taking civil-service examinations.

Ruling Against Discriminatory Water Rates to Railway

DISCRIMINATORY water rates in favor of the Chicago & Alton Railroad Co., as compared with the City of Slater, Mo., have been ruled against by the Missouri Public Service Commission. (*Public Utility Reports, Annotated*, June 5, 1919). The Saline Water & Power Co. has as its chief customers the railway company and the city named, supplying an average of about 70,000 gal. a day to the city and 312,000 gal. to the railway. Electric power is used for pumping, at a cost of some 14.32c. per 1000 gal. for current alone. The price paid by the water company for power was recently increased, by permission of the utility commission, from 1½ to 4c. per kilowatt-hour. A 20-year contract made in 1916 provided that the company should supply the railway with water at 8c. per 1000 gal. for quantities ranging from 300,000 to 500,000 gal. a day and at 5c. for all in excess of the latter amount. Subject to a minimum charge of $25 a day, water has been sold to the city at the following rates per 1000 gal.: First 100,000 gal. a day, 25c.; second, 20c.; all above 200,000 gal., 5c. The company petitioned the commission for a general increase in rates that would give it an average yield of 21.2c. per 1000 gal., with such adjustment between the city and the railway as the commission might see fit to make. The commission held the railway contract rate "unduly preferential and unreasonably discriminatory as against other consumers, especially as against the City of Slater," noting that the rate was about half the cost for current to pump the water, with no allowance for either operating expenses or for capital charges. It held that the contract is not binding as against the order of the commission in setting aside so discriminatory a rate, and that the jurisdiction of the commission is not affected by Federal control of the railway in question.

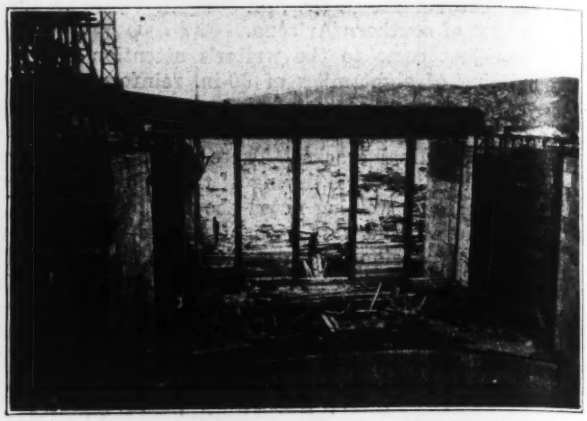
As to future rates the commission suggests: (1) That the city pay a fire protection charge of $4000 a year and (2) that there be a uniform charge to all consumers of 25c. per 1000 gal. for all water used up to 3,000,000 gal. a month (100,000 gal. a day); 22c. for any part of a second like monthly amount; and 20c. for all above 6,000,000 gal. a month.

Dam Supported by Bascule Bridge Closes Canal Lock

Steel Beams and Panels Placed From Bridge Form Temporary Dam Permitting Repair Work in Trolhattan Canal

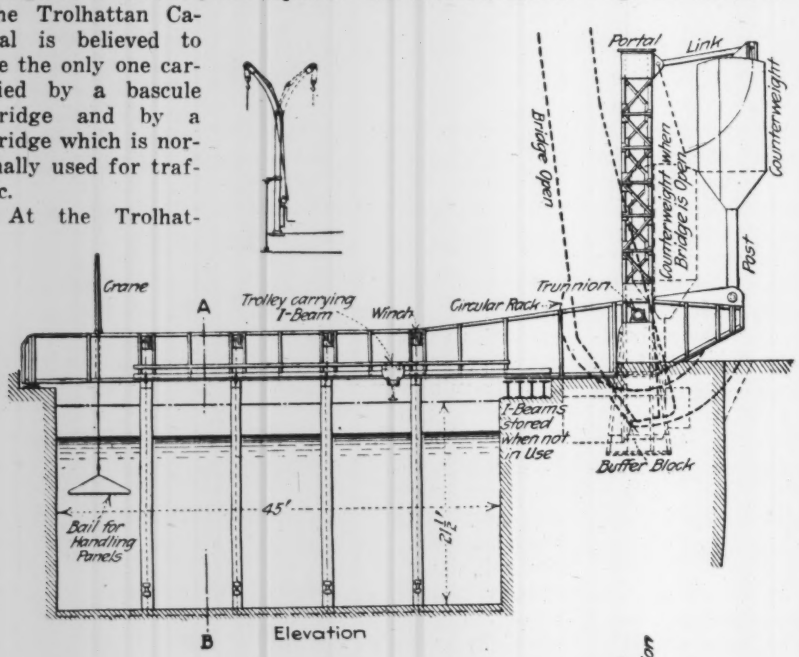
TO CLOSE the lock of the Trolhattan Canal at Strom, Sweden, in order to permit of repairs to the lock or gates, a movable emergency dam of the panel type is provided, and is carried by a highway bascule bridge which spans the lock channel. The dam is attached to the bridge only when the channel is to be closed. The Government canal was described in *Engineering News* of Feb. 22, 1917, p. 297. Particulars and drawings of the bridge and emergency dam have been furnished by K. A. Froman, chief assistant engineer of the canal work, under Lieutenant A. Ekwall, Corps of Royal Engineers.

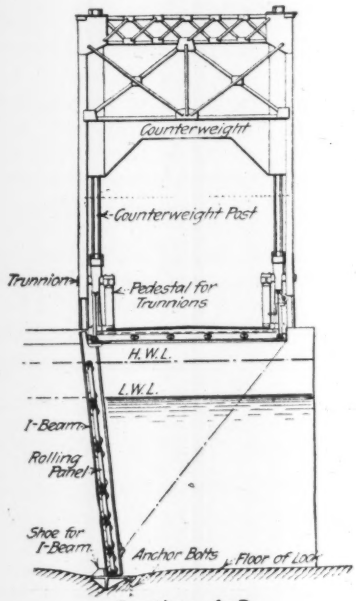
Larger dams of this type, but carried by swing bridges, are in use at locks on the Panama and Sault Ste. Marie Canals. In these structures, however, the framing of the dam is attached permanently to the span, which does not serve traffic purposes but stands normally in the open position and is only swung across the channel when the dam is to be closed on account of accident to the gates or necessity for repairs. The movable dam at the Trolhattan Canal is believed to be the only one carried by a bascule bridge and by a bridge which is normally used for traffic.

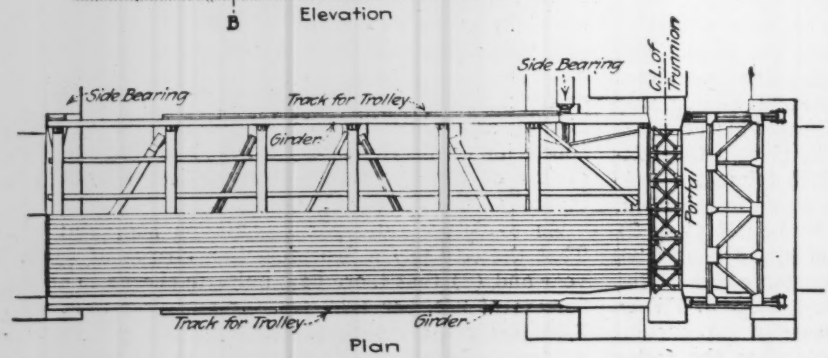


LOCK CAN BE CLOSED BY DAM ATTACHED TO BRIDGE

At the Trolhattan Canal the lock channel has a width of 45 ft. and a total depth of 25½ ft. below the roadway level, providing for 21½ ft. of water at high-water stage. The bridge is of plate-girder construction. Four inclined 22-in. I-beams spaced 9½ ft. on centers form the main frame of the dam, having their upper ends supported by the bridge and their lower ends resting against shoes in a recess across the floor of the lock.







BEAMS LOWERED FROM BASCULE BRIDGE CARRY PANELS FORMING EMERGENCY DAM IN CANAL LOCK

A similarly inclined 15-in. I-beam is installed in a recess in the face of each lock wall. Steel panels close the spaces between the beams. Normally, the four larger I-beams stand on the wall of the lock, beneath the bridge.

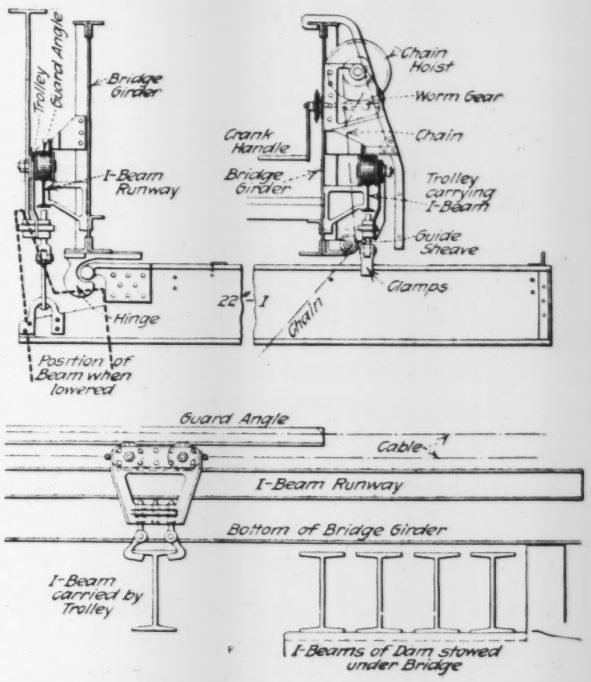
Outside of each girder of the bridge are brackets carrying an I-beam runway for a trolley, and above this is a guard angle to prevent the flanged wheels of the trolley from leaving the runway. On the downstream side is a

trolley having a hanger which engages a loop or stirrup on the end of the I-beam. On the upstream side is a trolley which carries the end of the I-beam by a pair of screw-operated clamps which hook over the top flanges of the beam, as shown in the bottom part of the drawing at the right. This end of the beam has an attachment for a chain, and the bridge girder has a chain hoist or winch attached to its web at each position for a beam forming the dam. The winch is operated by a crank handle and worm gear. Each trolley is operated by an endless cable, passing over sheaves on the girder.

The end sheave on one side is driven by a crank handle, the corresponding sheaves on the opposite girder being driven from this by a train of gears with shaft under the bridge floor, as shown in the upper part of the drawing at the right.

When the lock is to be closed, the two trolleys pick up the first I-beam and carry it out under the bridge into position. This brings its heel pivot into engagement with a hook or hinge bearing attached to the bottom of the downstream girder, and the chain on the upstream girder is hooked to the lug on the free end of the beam. When two beams have been carried out and are held in the horizontal position they are connected by cross-pieces to form a rigid frame and this is then lowered by paying out the chains, until the lower end of each beam rests against the stop or shoe in the floor of the channel.

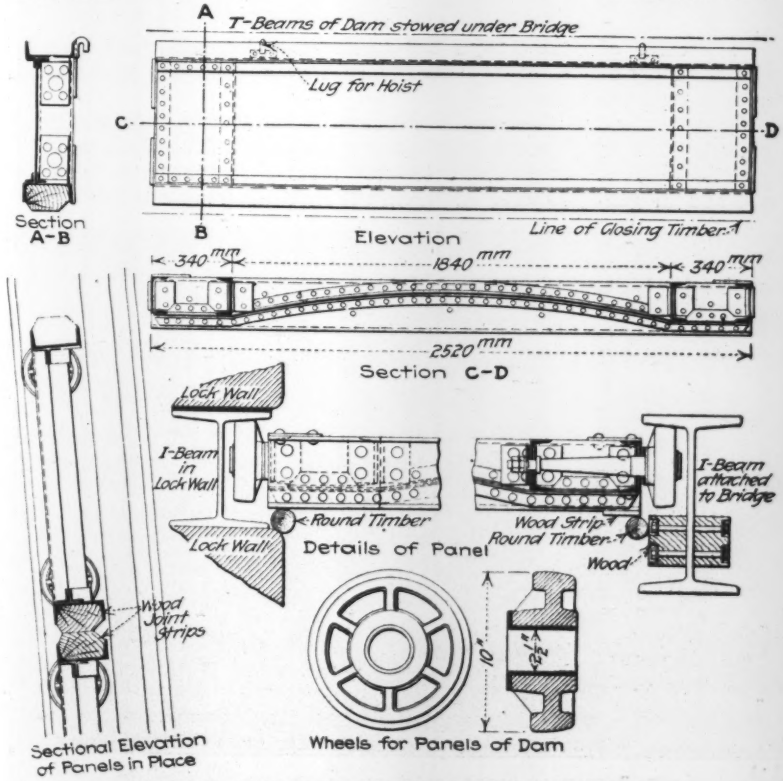
When the four beams are in position, the steel panels are carried out on a truck on the bridge floor, and are swung out over the up-stream girder by a crane of the davit type, which then lowers them in place between the I-beams. This crane is of 1½-ton capacity, operated by hand, and is set in sockets provided along the girders.



BEAMS FOR DAM ARE HANDLED BY TROLLEYS ON RUN WAYS ATTACHED TO THE BRIDGE GIRDERS

The cable of the crane carries a bail with hooks engaging lugs on the panels. These panels are of three sizes. Each is made of a buckle plate, with flange angles, and is fitted with four 10-in. cast-iron wheels having bronze bushings and casehardened rims shaped to fit the flanges of the I-beams. Wood sills on the panels provide for making the horizontal joints water-tight. For the vertical joints there are wood strips secured to the sides of the panels, a round stick closing each joint by fitting against these strips and a sill bolted to the web of the I-beam. At the joint at each side wall is another round stick closing the opening between the panels and the masonry.

Horizontal diagonal bracing is used in the floor system of the bridge in order to provide rigidity for resisting the horizontal pressure due to water against the dam. This thrust is taken up by side bearings anchored in the ground and engaging shoes on the side of the downstream girder. The bridge is of the trunnion bascule type and has two plate girders with floor-beams resting on the bottom chords and I-beam stringers between them. Floor planking is spiked to sills resting upon the stringers and upon shelf angles on the webs of the girders. These girders are spaced 19 ft. c. to c., but the inner pedestals for the bearings reduce the roadway width to 15½ ft. The outer pedestals form part of the portal columns to which is attached the counterweight.



ROLLING PANELS FORM THE FACE OF THE DAM

Segmental racks on the heels of the girders engage with operating pinions on a cross-shaft driven by gearing from a 24-hp. motor. Hand operation is also provided for, and there is a safety brake of sufficient power to hold the bridge in any position. Designs for this structure were made by the Strauss Bascule Bridge Co., Chicago, under the direction of the Royal Waterfalls Commission.

American Engineers Make Records In Bridging the Rhine

In Successive Trials Army Engineers Reduce Time of Ponton Construction Across River to Forty-One Minutes

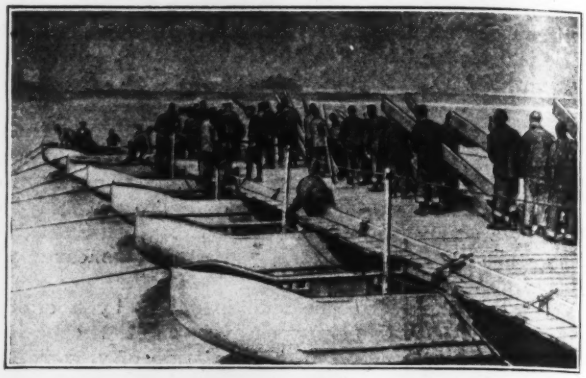
American Army engineers are engaged in friendly competition at the Ponton School at Hönningen, Germany, where they are making records in throwing ponton bridges across the Rhine. Two of these records were recently made, and each has been reported by officers concerned.

Second Engineers Take Fifty-Eight Minutes

By James M. Farrin
Captain, Corps of Engineers, U. S. A., A. E. F., Germany

AMERICAN engineers built a bridge across the Rhine at Hönningen on May 25, 1919, in 58½ minutes. The structure, shown in the two airplane views, was a ponton bridge and was put up by the Second Engineers of the Second Division of the Army of Occupation. One of the pictures shows the entire structure completed and was taken from an altitude of 1000 m., while the other from an altitude of 200 m. shows the progress of the construction, the disposition of the working parties, and other details of the bridge.

The 3rd Corps Ponton Bridge School is located at Hönningen, where has been collected a large supply of German ponton material, and where also each engineer regiment of the 3rd Corps sends details for a 10 days' instruction course. The Rhine at this place is 1440 ft. wide and has a current of nearly 7 km. per hour. It is approximately 25 ft. deep in midchannel, and in general has a rocky bottom. These facts alone are sufficient to make its bridging no easy matter.



AMERICAN BUILT PONTON BRIDGE ACROSS THE RHINE AT HÖNNINGEN

Authority had been secured to suspend all traffic on the Rhine in this vicinity for two hours on Sunday morning, May 25. At 9:15 a.m. on that day the abutment was started, and at 10:13½ a.m. the last side-rail lashing was finished. The method of "successive pontons" was used throughout; the average time for the construction of a bay being 1¼ minutes. The construction proceeded without mishap and with clocklike precision to a junction in the center, where the bridge was closed without any difficulty whatever.

Each boat was equipped with a 125-lb. anchor, which was cast at a point about 150 ft. upstream from the bridge. In such a swift current and with a rocky bottom it was expected that some of the anchors would drag, but fortunately this only happened in one case. This boat was quickly pulled back to position by a launch stationed nearby. In addition to the boat anchors there were 500-lb. anchors placed in midstream as a safeguard and every fourth boat had a downstream anchor.

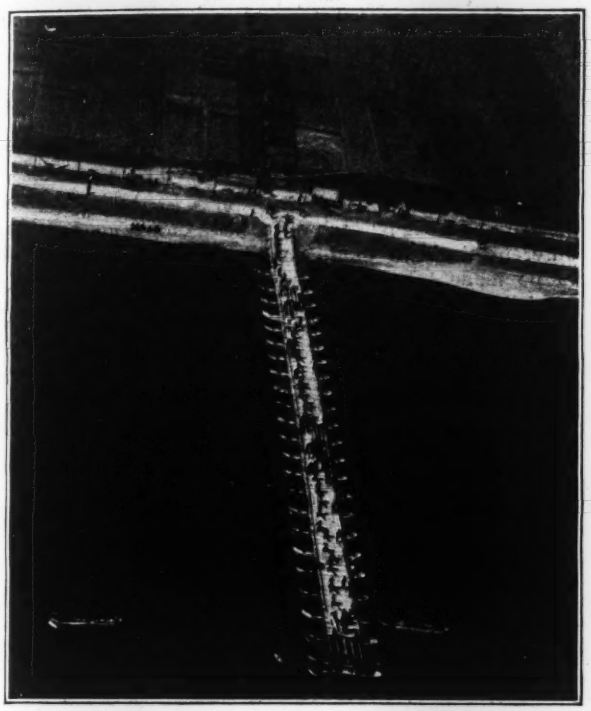
The equipment used in the construction was all captured German ponton equipage, and consisted of 91 steel boats and 3 trestles, making 95 spans in all, of which 49 were laid from the right-hand bank and 46 from the

BUILDING A PONTON BRIDGE ACROSS THE RHINE AS SEEN FROM AN AIRPLANE 200 METERS UP

left; 665 pieces of 6 x 4 in. by 18 ft. balk; 1615 pieces of 1½-in. flooring plank; 190 pieces of 6 x 4-in. guard rail and 1330 pieces of ½-in. lashing.

Soon after the bridge was completed, Battery B of the Twelfth Field Artillery crossed with full equipment.

The Ponton School at Hönningen was established by Col. H. C. Fiske, Chief Engineer, 3rd Corps. The bridge



ARMY ENGINEERS WORKING ON RHINE PONTON BRIDGE PHOTOGRAPHED FROM AIRPLANE

detail comprised 400 men, half of whom had received 10 days of training, the other half only three days. The ends of the bridge were in charge of Capt. William C. Atwater, Company F, and First Lieut. Lyman McE. Chase, Company D, working under the direction of Maj. Theodore Wyman, Jr., and with the supervision of the regimental commander, Col. Stuart C. Godfrey.

First Engineers Build Bridge in Forty-One Minutes

BY SAM H. ANDREWS
First Lieutenant, Engineers, U. S. A., A. E. F., Germany

ON JUNE 8, at Hönningen, Germany, the First U. S. Engineers, commanded by Col. E. J. Atkisson, by bridging the Rhine River in 41 min. 8⅔ sec., accomplished a feat which should be made known to the entire engineering world.

The bridge was built by successive bays from both banks of the river. The material was piled on the bank and the men were in company formation when the signal to start was given.

Every man of every detail was working 100% efficient to beat the splendid record established by the Second U. S. Engineers when they completed the bridge with the same material at the same place and with the same number of men in 58½ minutes. The data in making the record are as follows:

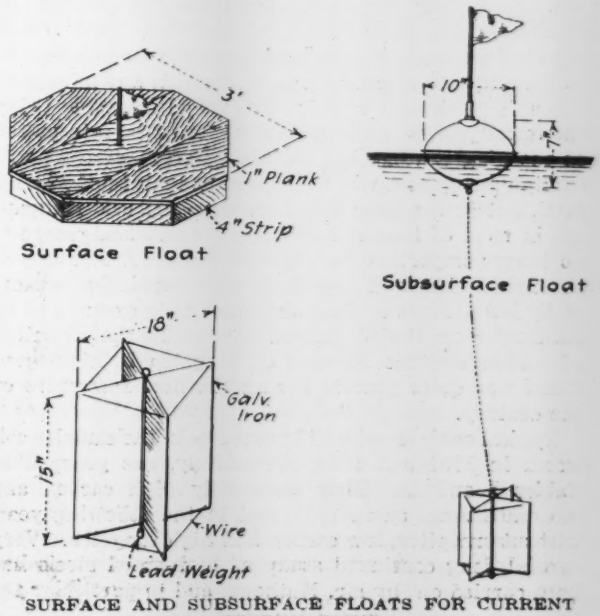
Weather: Fair, downstream 8-mile wind.
Current: 4 miles per hour.
Span: 1450 ft.
Time: 41 min. 8⅔ sec.
Detail: 1 major, 4 captains, 8 lieutenants, 3 master engineers,
398 men and N. C. O.'s.
Material: 92 boats (9-ton displacement),
3 trestle bents,
500 balk (4 x 5½ in. x 25 ft.),
192 side rails (4 x 5½ in. x 19 ft.),
1632 chess (1 x 10 in. x 11 ft.),
102 anchors (175 lb.),
20,500 ft. 1¼-in. rope,
2900 ft. ¾-in. rope,
192 hand-rail supports,
576 rack sticks,
Best previous record by Germans:
1 hr. 30 min., under same conditions.

The bridge was designed to carry divisional traffic, including artillery, and immediately after the completion of the structure a long line of automobiles together with foot troops crossed to the other shore.

Floats Show Course of River Currents

IN OBSERVATIONS of currents at the mouth of the Southwest Pass or outlet of the Mississippi River, both surface and submerged floats were employed to determine the movements of surface and subsurface currents. These floats are shown on the accompanying drawing and are described by T. E. L. Lipsey, assistant engineer in charge, in a paper in the "Professional Memoirs of the Corps of Engineers, United States Army," January-February, 1919.

Surface floats were flat, octagonal in plan, 3 ft. wide, and built up of 1-in. boards on 4-in. strips placed diagonally and across the perimeter. The size was made as large as could be handled conveniently, in order



SURFACE AND SUBSURFACE FLOATS FOR CURRENT OBSERVATIONS

to present as large an area as possible to the current and to reduce to a minimum the effect of wind on the small staff and flag necessary to make the float discernible in the water. The total surface area was 180 sq. in., while the surface presented to the wind was 6 sq. in., and as the staff was round the ratio of wind effect to current effect was about 1 in 50.

The submerged float was made of two L-shaped pieces of heavy tin, or No. 20 galvanized iron, riveted together in the form of a cross, and having the wings tied together with wire, as shown, a small weight being attached to the bottom to maintain the float in a vertical position in the water. It was suspended at the required depth by means of a fine braided line attached to a copper buoy carrying a small staff and flag. The shape of the buoy, an oblate spheroid, practically eliminated impact of the surface current, while the skin-friction effect of the current was almost negligible. With the submerged float attached the buoy had a draft of about four inches.

In making observations, Mr. Lipsey explains, the floats were dropped from the tug at the desired starting points and located at intervals of from 15′ to 45′ by sextant readings to fixed marks on shore and by ranges on shore whenever these were available. Each location was determined by two angles and checked by a third angle and by ranges whenever possible. A protractor was arranged with the circles representing the loci of points, subtending equal angles from the fixed points on shore and with all available ranges drawn in. On this the locations were plotted on the boat as the observations were made. In this way from two to six floats, started from different points, could be followed at a time by one party.

Compositions and Efficiencies of High-Speed Steels

LOW-CARBON high-tungsten steel was developed in 1902, and this development constituted the origin of modern high-speed steels as distinguished from the earlier Mushet air hardening steels, says John A. Mathews in a paper on "Modern High-Speed Steel" read before the American Society for Testing Materials. In recent years a further transformation has been gone through, with the addition of vanadium, and today the term "modern high-speed steel" must be interpreted as meaning a vanadium-containing steel.

High manganese was an important feature of Mushet steel, but in the later '90s chromium replaced manganese in most of the air hardening steels. Manganese is no longer important in high-speed steels. Apparently through accident, it was later discovered that abnormally low carbons enabled abnormally high results to be obtained from the steels, and as a result the reduction of carbon and the increase of tungsten in high-speed steels was quite general during the first few years of the century.

Typical analyses of well known steels, the samples collected in 1901 and 1902, respectively, are grouped in Tables I and II. They show only high carbon and moderate tungsten in 1901, and in the following year, without exception, low carbon and high tungsten. Very careful, long continued study of high-speed steels has been carried on by Mr. Mathews, and in particular the magnetic properties of alloy steel have been examined

TABLE I. SELF-HARDENING STEELS, 1901

Maker No.	Carbon, per Cent.	Manganese, per Cent.	Chromium, per Cent.	Tungsten, per Cent.	Molybdenum, per Cent.
1	2.19	1.32	0.50	5.63	....
2	1.69	0.45	3.73	7.63	....
3	1.14	0.33	2.09	7.98	....
4	1.79	0.50	3.96	....	4.54
5	1.55	0.24	3.22	7.80	1.10
6	1.55	0.21	3.67	9.42	....
7	1.78	1.18	....	7.22	....
8	1.40	1.65	3.69	....	4.59
9	1.75	3.92	....	6.61	....

TABLE II. HIGH-SPEED STEELS, 1902

Maker No.	Carbon, per Cent.	Manganese, per Cent.	Chromium, per Cent.	Tungsten, per Cent.	Molybdenum, per Cent.
21	0.63	....	4.00	....	6.00
22	0.42	....	4.95	10.75	....
23	0.57	0.43	3.30	11.58	....
24	0.75	....	....	19.50	....
25	0.37	....	5.10	13.83	....
26	0.62	....	6.50	21.06	....
27	0.84	0.07	2.76	11.25	....
28	0.56	....	2.95	9.74	....
29	0.60	0.30	....	....	9.25

carefully. However, neither physical nor magnetic measurements show such differences between essentially different steels as would enable proper discriminations to be made. Four steels have been subjected to a specially careful study. These are modern high-speed steels with analyses as given in Table III. Cutting tests made according to the method described by Frederick W. Taylor rank these four steels about as follows: Taking No. 33 as 100% in efficiency, No. 34 rates 70%, No. 32 66%, and No. 31 only 45 per cent.

Vanadium is the only general addition, says Mr. Mathews, that has been made to the earlier types of high-speed steels which seems to afford universal improvement in quality. It benefits tungsten-chrome as well as molybdenum-chrome steels. Cobalt and uranium

TABLE III. ANALYSES OF FOUR STEELS USED IN TESTS

Steel No.	Carbon, per Cent.	Silicon, per Cent.	Manganese, per Cent.	Chromium, per Cent.	Tungsten, per Cent.	Vanadium per Cent.
31	0.63	0.19	0.26	4.21	13.10	0.25
32	0.61	0.19	0.36	3.34	16.28	0.40
33	0.63	0.27	0.31	2.99	16.87	0.85
34	0.64	0.22	0.24	5.35	18.99	0.15

have been discussed as ingredients which will improve high-speed steels, and even cerium and zirconium have been tried, so far without conclusive indication of their value.

While the introduction of vanadium and the improvement in the quality of raw materials have been important factors in improving high-speed steels, yet it appears that steel-making rather than chemical analysis is the first consideration. In a very elaborate series of tests, including over fifty analyses, it was noted that in those fields included in the first group as to merit, the compositions varied from 12.70 to 18.59% of tungsten, from 1.70 to 5.58% of chromium, from 0.40 to 1.73% of vanadium and from 0.52 to 0.81% of carbon; and the steels rated as second and third class in general covered almost identically the same materials.

Air Patrols to Detect Forest Fires

Airplane fire patrols over the great forest reserves of California were recently inaugurated. Forest fires can be located from the air within a few miles of their actual position. Two patrols daily, leaving Warner's Hot Springs at 10 a.m. and 3 p.m., cover a route about 110 miles in length in that portion of the Cleveland National Forest adjacent thereto. Wireless telephones are used to communicate with the base, which at once telephones to the nearest forest rangers' post.

Rules for Drafting Practice

Cover Concisely Dimensions of Drawings, Allowable Scales, Character of Lettering and Many Other Points

SOME ten years ago H. N. Savage, then with the United States Reclamation Service and now hydraulic engineer for the City of San Diego, Calif., drew up the following rules regarding drafting practice. They have been in use ever since on his projects, with excellent satisfaction:

Drawings should conform to the following sizes, several sheets being used if necessary, supplemented with an index sheet:

Out to Out	Inside Border
8 x 11 in.	7 x 10 in.
11 x 16 in.	10 x 15 in.
16 x 22 in.	14½ x 20½ in.
22 x 32 in.	20½ x 30½ in.
32 x 44 in.	30½ x 42½ in.

Drawings of 10-in. vertical dimension, inside border, may be made any length necessary over 15 feet.

Trimming lines for drawings should be drawn on each tracing and the tracing cut ¼ in. outside these lines. Paper drawings should be cut to the same dimensions as tracings.

Tops of drawings should orient with north cardinal point.

Maximum dimension of drawings should be horizontal.

Do not abbreviate any words on drawings.

Sufficient legends should be used to identify all parts of a drawing.

Drawings must be independently checked with a degree of accuracy commensurate with the importance of the work involved.

The initials of the persons who draw, trace and check a drawing should be shown in the lower left-hand corner thereof. Those of the checker should be affixed by him in writing; the others should be printed.

The names of the supervising and project engineer or engineer in charge should appear on all drawings, but may be printed on drawings not requiring approval. Drawings of projected work and drawings involving policy, after being signed by the project engineer or engineer in charge, and before construction is begun, must be submitted to the supervising engineer, and if they are approved separate prints will be furnished to the project or feature office. Approved tracings will usually be retained in the files in the supervising engineer's office.

The subject of the drawing should form the major feature of the title, as, "Lower Yellowstone Dam." Such words as "map," "plat," "sketch," "location," "proposed," etc., should not be used in titles.

Drawings accompanying correspondence should be stamped on the margin "Transmitted to.....with letter dated.....19..," or, "Received from .....with letter dated .....19..", appropriate name and date being written in ink.

Paper drawings and prints should be folded right side out to letter size, title on top.

Only a minimum amount of work should be done on pencil drawings which are to be traced. Whenever practicable, preliminary penciling should be done directly on the tracing cloth.

Every tracing, in advance of its making, should receive an appropriate title and project number. Project and supervising engineers' file numbers should be placed on the margin in the lower right-hand corner.

Lettering on drawings should be placed to be read from the lower right-hand corner of the drawing. Plain single-stroke letters should be used except on drawings requiring distinctions between different kinds of names. Liberal and uniform spacing should be provided between words. Inclined Gothic lettering should be used on structural and mechanical drawings; capitals for special emphasis and in titles; lower case for general description and notes. Lettering on drawings 11 x 16 in. or over should be of sufficient size to be legible when the drawings are reduced to one-half the original dimensions.

Contract drawings, except profiles, for photolithographic reproductions should be prepared for a reduction to about two-thirds the original dimensions, and to come down to a vertical dimension of 10 in. between the border lines. Profiles should be prepared for reduction to one-half the original dimensions, with a vertical dimension of 10 in. between the border lines. Where possible, two lines should be placed on a sheet. The horizontal scale of profiles should be made as small as practicable. Lettering on contract drawings intended for photolithographic reproduction should be in pencil, the final lettering being left to be put on in the director's office with standard type.

Drawings of land should show legal subdivisions or other coördinate lines referred to some fixed point, as section or quarter-section corners.

True north, also magnetic north if known, should be indicated on each drawing of land unless section lines are shown.

Vertical sections and elevations taken across a stream or canal should be shown looking downstream. Vertical sections and elevations taken along a stream or canal should, wherever practicable, show stream flowing from left to right. Stationing of profiles should, wherever practicable, increase from left to right of the drawing.

The direction of streams and of canals through structures should be shown by arrows.

Contours should be in 1-, 2-, 5-, 10-, 20- or 100-ft. intervals. Contours and figures showing their elevations should be in burnt sienna. Distinguishing contours should be of deeper color.

Graphic scales should be shown on each drawing. Following are approved scales:

For maps and allied drawings, 10, 20, 40, 100, 200, 400, 500, 1000 and 2000 ft. and ½, 1, 2, 5 miles, and even multiples of 2 and 5, to an inch.

For engineering structures, ⅛, ¼, ½, 1, 3 and 6 in. per foot, and 10, 20 and 40 ft. to an inch.

For mechanical and architectural drawings, 1/16, 1/8, ¼, ½ and full size.

Public Comfort Station Law in Wisconsin

Every city and incorporated city in Wisconsin must "provide and maintain a sufficient number of suitable and adequate public comfort stations for both sexes," under a law passed recently by the state legislature and signed by the governor. It is provided that the State Board of Health shall establish rules and regulations governing the location, construction, equipment and maintenance of such stations and may also prescribe minimum standards that shall be uniform throughout the state.

Building the New Orleans Army Supply Base

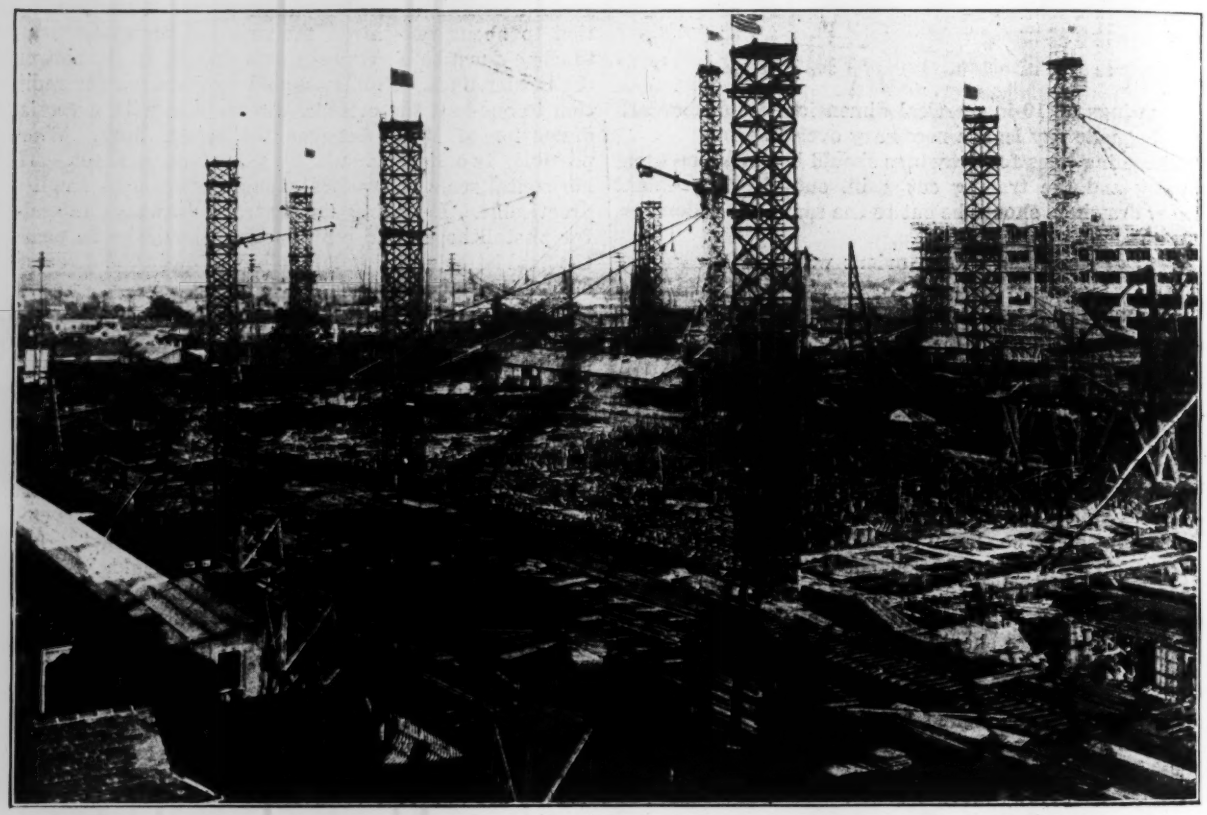
Features of the Work Are the Large Concentration of Equipment, the Use of Seven Miles of Temporary Railway Track and the Rapid Construction of So Large a Project

SPEED and efficiency of construction in the New Orleans Army supply base were not obtained by any novel methods, but by the application on an extensive scale of those already well tried. In consequence, this third largest of the great overseas port terminals for the Army, a project totaling $15,000,000 in cost, is being carried to completion in record time.

The base, which was described in detail in *Engineering News-Record* of Apr. 24, 1919, p. 823, is located on a 48-acre tract of land along the Mississippi River, and consists of three warehouses, each 140 x 600 ft., six stories high, constructed of reinforced concrete on pile foundations; a creosoted-pile and timber wharf surmounted by a wharf house 140 ft. by 2000 ft., two stories high, constructed of structural steel, with galvanized corrugated-iron siding; and three multiple-story bridges connecting the warehouses with the wharf. One of these bridges has ramps at four levels and two have ramps at two levels, each bridge being about 400 ft. long by 26 ft. wide, constructed on pile foundations of structural steel with reinforced-concrete floors and galvanized corrugated-iron siding and roof.

In addition to these principal structures, there is a great deal of collateral construction, including railroad tracks and yards, totalling approximately nine miles of single-track equivalent, reinforced-concrete pavements around the warehouses, a complete fire-protection and water-supply system, a sewerage and drainage system, and an electrical distribution system including six transformer stations, a telephone system, and a fire alarm and watchman's supervisory system. The cost of the entire project is approximately $15,000,000.

In the construction of so large a project in a short time, the storing and handling of large quantities of materials constitute one of the most important problems. The large quantities of materials of the various classes noted which are required in the construction are apparent from the following table, which gives the approximate quantities of the principal item:



SHORE END OF WAREHOUSE GROUP AT NEW ORLEANS ARMY BASE UNDER CONSTRUCTION

Piles	53,000 pieces
Sand	52,500 cu.yd.
Gravel	105,000 cu.yd.
Cement	187,000 bbl.
Reinforcing steel	8,000 tons
Structural steel	5,500 tons
Steel sash	136,000 sq.ft.
Form lumber	9,000,000 ft.b.m.
Creosoted timber	5,000,000 ft.b.m.
Untreated timber	2,000,000 ft.b.m.
Creosoted wood-block flooring	37,000 sq.yd.
Roofing	5,320 squares

The material storage and handling problem has been complicated by the location of the work adjacent to the industrial ship canal in course of construction, which totally cuts off the project from one side. The work is, however, located immediately adjacent to a bend in the Public Belt R.R., which provides it with rail connections. This is of particular value, as all construction

material is received by rail. A complete system of some seven miles of temporary track has been installed, connecting the construction work with the belt railway on both sides of the bend, with the Louisiana Southern Ry. near the work, and connecting the various portions of the work with the material-storage yards, located approximately one-half mile distant.

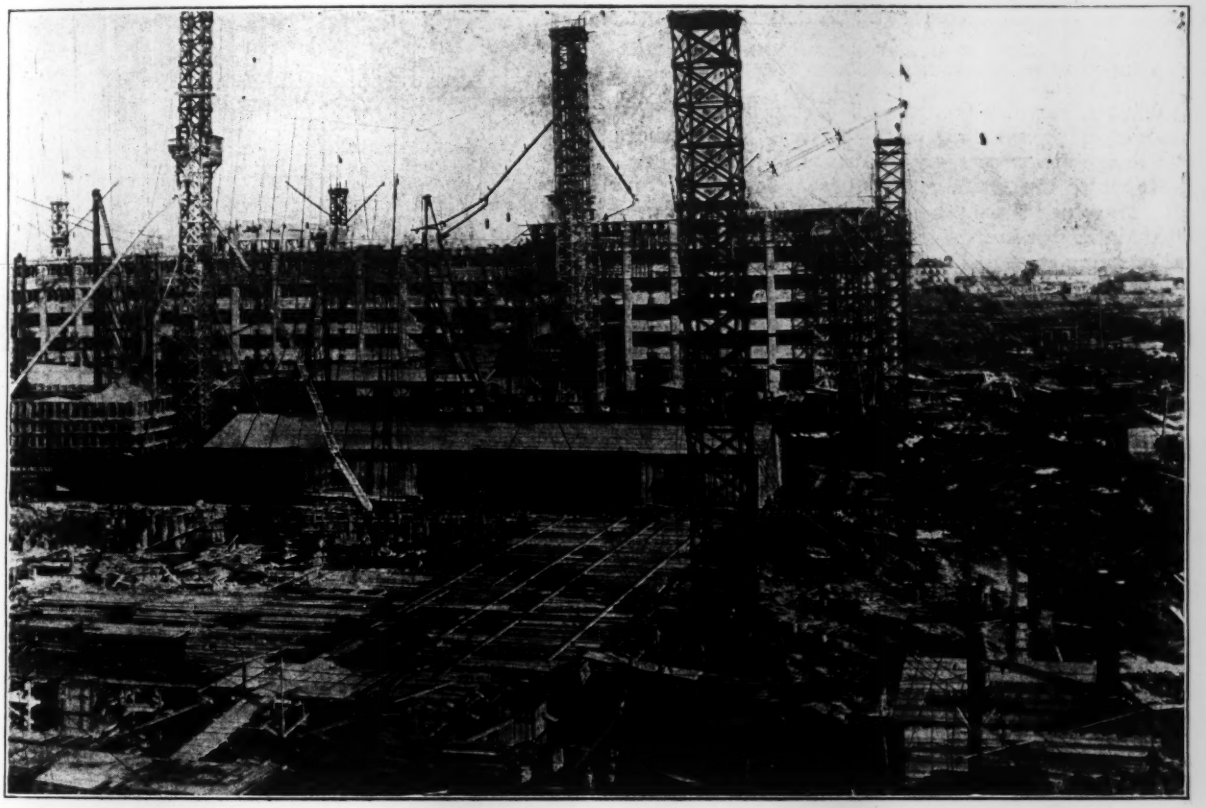
Incoming materials are delivered directly to the unit in which they are to be used, or, if not immediately required, to storage yards. The material-handling equipment includes seven locomtives, 12 locomotive cranes and nine derricks. Six of the locomotives are rebuilt six-wheel Mogul-type locomotives from the Panama Canal, which handle practically all of the switching, being supplemented by a small standard-gage saddleback locomotive.

The ample material-handling equipment has been an important factor in making possible the several construction records established on this job. The record day's work for car unloading is 207 cars, and at all times the requisite flow of materials has been maintained to permit, simultaneously, the rapid construction of all of the structures comprising the base. After the completion of the foundations for the warehouses, upon which no very fast progress could be made on account of the conditions encountered, the work has gone forward rapidly, an average of a complete floor being poured every week on each warehouse. The concrete in the superstructure of the last warehouse to be completed was poured in 34 working days, the foundation being completed Mar. 25 and the roof slab May 3.

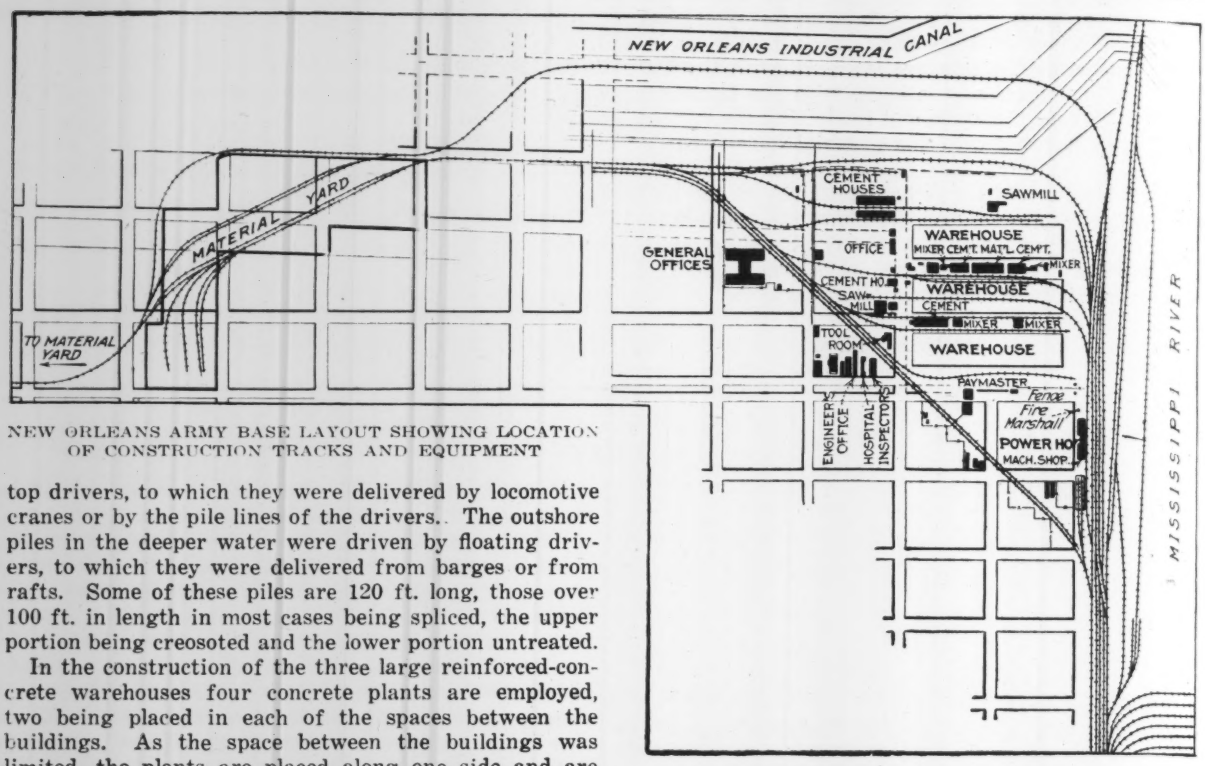
Ample construction equipment is provided, mechanical devices being used wherever possible, to expedite the work. Bulk excavation for the warehouse foundations was handled by dragline excavators which delivered the material to railroad cars, from which it was unloaded mechanically. After the completion of the piledriving, the small amount of excavation remaining was done by hand.

Untreated piling was driven under two of the warehouses to a point below the plane of saturation of the ground. This was driven by ordinary top drivers equipped with steam hammers. The piles were unloaded from cars immediately adjacent to the work and were handled to the drivers by the pile lines of the drivers themselves. In the middle warehouse, the execavation was avoided by the use of composite piles. An ordinary, untreated wooden pile with a turned head was driven to the ground level with an ordinary pile-driving rig and followed down to below the saturation plane with a Raymond steel collapsible core carrying with it a spirally reinforced steel shell. After this core was withdrawn dowels were driven into previously bored holes in the top of the wooden pile and the shell was filled with concrete, thus forming a composite pile of wood below the saturation plane and of concrete above. These piles were capped by a combined foundation cap and first-floor slab, the bottom of which is at approximately the original ground level. One of the finished composite piles withstood a 40-ton test load and showed no measurable settlement.

In the wharf the piles near shore were driven by



RIVER END OF WAREHOUSES (CONNECTING WITH VIEW ON OPPOSITE PAGE)—DOCK AT RIGHT NOT SHOWN

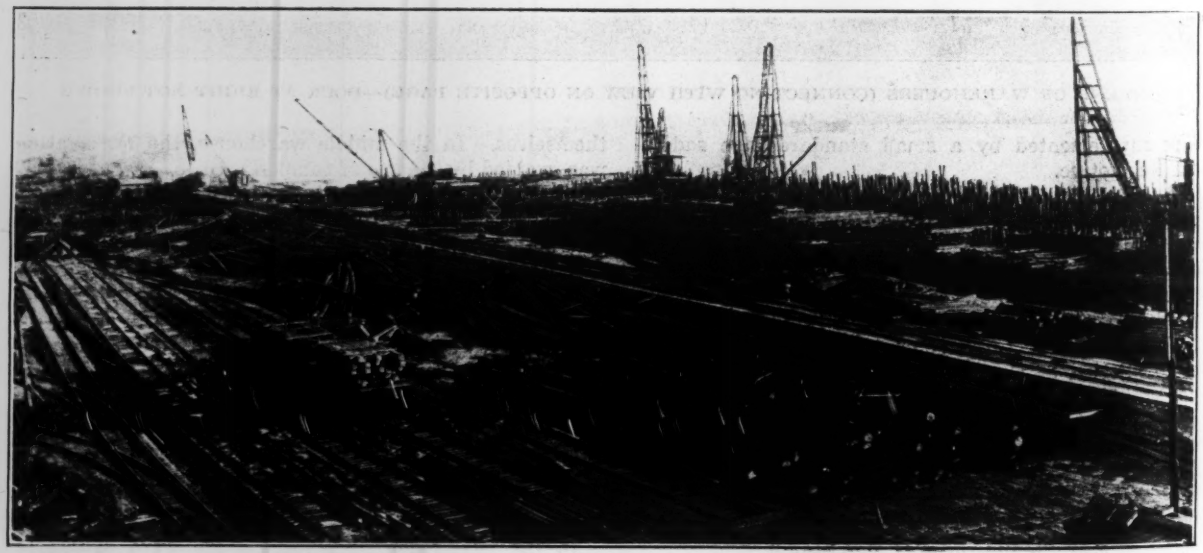


NEW ORLEANS ARMY BASE LAYOUT SHOWING LOCATION OF CONSTRUCTION TRACKS AND EQUIPMENT

top drivers, to which they were delivered by locomotive cranes or by the pile lines of the drivers. The outshore piles in the deeper water were driven by floating drivers, to which they were delivered from barges or from rafts. Some of these piles are 120 ft. long, those over 100 ft. in length in most cases being spliced, the upper portion being creosoted and the lower portion untreated.

In the construction of the three large reinforced-concrete warehouses four concrete plants are employed, two being placed in each of the spaces between the buildings. As the space between the buildings was limited, the plants are placed along one side and are served by a railroad track along the other side of the space. Each mixer plant consists of a 28-cu.ft. mixer with stationary steel measuring hoppers feeding directly into the drum, and an automatic water measuring tank. The measuring hoppers are fed from wooden bins above them. The cement is raised to the hopper floor from cars or a storage shed on a belt conveyor which runs the full length of the cement shed and which dumps the cement into a wide steel-lined chute leading close to the measuring hoppers. By this arrangement the cement handling is made as light work as is possible with cement in bags. The sand and gravel bins over the mixer are fed by belt conveyors from storage bins into which the sand and gravel are placed from the cars by a derrick equipped with a clamshell bucket of 1½-yd. capacity. The concrete is hoisted in a 1-yd. bucket and chuted to place or to floor hoppers, from which it is buggied to place. Line gates are provided along the length of the main chute so that concrete may be taken into branch chutes at any one of several points.

In the construction of the platforms surrounding the buildings, and of the reinforced-concrete roadways, the concrete is conveyed from a central mixer plant to its destination in hoppers mounted on railroad cars handled by a switch engine. Two cars are used, one carrying



BUILDING THE ARMY BASE WHARF ON THE MISSISSIPPI LEVEE

four 2½-yd. hoppers, and one carrying two 7-yd. hoppers, or a total of 24 yd. The reinforced-concrete canopies surrounding the buildings are poured from hoppers raised to the proper elevation by a locomotive crane, the concrete being mixed at a central plant and carried in hoppers mounted on railroad cars to a track immediately adjacent to the work. Concrete firewalls constructed at intervals of 200 ft. in the wharf house are likewise poured from hoppers hoisted to the required elevation by a locomotive crane, this concrete being mixed in a plant mounted on railroad cars on a track adjacent to the work.

List of Equipment

The forms for the reinfroced-concrete work are, wherever possible, made up in units fabricated in a mill. These units are carefully marked to indicate their destination, and are very rapidly erected in place. Concrete spreader blocks are used for wall forms, and concrete blocks for supporting the reinforcement. These are made under roof in suitable moulds, the spreader blocks being cast with a hole through them formed by a steel rod. The blocks are cured on pallets until they have received their initial set, and are later cured in stacks before being used. The spreader blocks make a firm separation for the wall forms, and will not fall out as the tie rods pass through them. They have the further advantage of permitting the easy withdrawal of the tie rods which pass through the holes in them.

28-ft. concrete mixers, electrically driven	4
½-yd. concrete mixer on wheels, steam driven	1
½-yd. concrete mixers on wheels, electrically driven	5
½-yd. concrete mixers on wheels, gasoline engine	2
Electric hoists, 50 to 90 hp	8
Steam hoisting engines, averaging about 40 hp	20
Clam-shell buckets, 1- to 1½-yd. capacity	10
Concrete chutes, 30-ft. sections	67
Concrete carts, two-wheeled	99
Locomotive cranes	12
Locomotives, 62-ton, six-wheel Mogul type	6
Locomotive, 24-ton, standard-gage saddleback type	1
Floating derrick	1
Stiffleg derricks	9
Hoist booms on towers	12
Floating pile-drivers	4
Tugboat	1
Land piledrivers	16
Centrifugal pumps, 2½-in. to 6-in	8
Air drill,[2] hammers, etc	100
Air-compressor, portable, 190-cu.ft. capacity	1
Air-compressor plant, 750-cu.ft. capacity	1
Air-compressor plant, 250-cu.ft. capacity	1
Machine shop with three lathes, three drill presses, shaper, power saw, forges, etc	1
Carpenter shop with five steel table saws, two swinging cut-off saws, two band saws, planer, boring machines, etc	1
Automobiles and trucks	29

When necessary for the rapid completion of the project the work has been carried on with two shifts of eight hours each, and for a short time three shifts were employed. For the work done at night a complete installation of electric flood lights is in place and is supplemented, where necessary, by strings of incandescent lights. The flood lights are set at different elevations on the various construction towers and on the completed portions of the buildings, and furnish very satisfactory illumination for night construction work.

As the concentration of equipment on the job is rather unusual, and as such excellent results have been obtained by its use, the following list of principal equipment is thought to be of interest.

Throughout the construction of the project, complete progress charts and schedules have been used, thereby keeping each administrative and executive office informed as to the exact status of each feature of the construction work. Charts have been prepared showing the anticipated progress or program of the work. A vertical column of subdivisions of the work, and a horizontal scale of time divided into weeks, form the axes of these charts. Heavy horizontal lines indicate the programmed duration of each subdivision of the work, and alongside these are posted at frequent intervals the actual amount of work completed to the date of posting. This is indicated by a line of length proportional to the percentage of work completed and having at its end the date of posting. A glance at such a chart indicates immediately just which items are behind or ahead of schedule. These diagrams are supplemented by time-percentage diagrams or curves for each complete structure of the project and for the project as a whole, the anticipated progress being indicated by a line of one color and the actual progress by a line of another color.

Pictorial Charts Used

In addition to the above diagrams, pictorial charts representing a longitudinal section of each building are used to indicate the general progress of the work. On these charts border lines, of various colors indicate forms placed, forms removed, etc., another symbol shows reinforcing steel placed, a tint of a certain color indicates concrete poured, and a tint of another color shows structural steel placed, and so on. Where the work has not been completed entirely across one bay of the building, outer lines or tints on that bay are shown broken, and in the case of vertical members are extended to a height proportional to the percentage completed.

All equipment is indicated by pins with variously colored heads representing different types, which are stuck into a map showing their location on the entire project.

The construction of the New Orleans Army supply base is under the general supervision of Brig. Gen. R. C. Marshall, Jr., U. S. A., chief of the Construction Division of the Army, and under direct charge of Lieut. Col. A. Pearson Hoover, constructing quartermaster, who went direct from the Boston Army supply base. Capt. C. R. Barnett is assistant constructing quartermaster. Ford, Bacon & Davis are supervising engineers of the base. The firm is represented by George H. Davis, member of the firm; Charles J. Hardy, New Orleans resident engineer, and Frank J. Trelease, engineer in charge. The George A. Fuller Co. is the general contractor for the entire work, and is represented by Walter T. Smith, vice-president of the company. The wharf and wharf-house construction was sublet by the general contractor to the Holbrook, Cabot & Rollins Corporation of Boston.

Why Engineers Are Not Appreciated

Seven reasons for the lack of appreciation of the engineering profession by the public were given by W. W. K. Sparrow, corporate chief engineer of the Chicago, Milwaukee & St. Paul Ry., in a recent installation address before the Cincinnati Chapter of the American Association of Engineers. They are as follows: Inadequate compensation; lack of organization; lack of initiative in public affairs; lack of publicity concerning the engineer and his worth and his relation to the better health, comfort and welfare of the community; lack of proper public regulation in the form of licensing; improper application of the definition of the term "engineer," and lack of general education and inability to speak well.

Opening Old Railroad Fill Reveals Reasons for Track Trouble

Embankment Originally Built Nearly 90 Years Ago Had Pockets of Gravel in Section Widened Much Later

By R. Reimann
Assistant Engineer, Baltimore & Ohio Railroad, Baltimore, Md.

METHODS of making railroad embankments could be materially improved if in every case where there was trouble a cross-section of the fill could be obtained. On account of the construction of a state road under the tracks of the Baltimore & Ohio R.R. at Elkridge, Md., a 90-year old fill there had to be opened some time ago, with resulting instructive results.

The Washington branch of the Baltimore & Ohio R.R. was constructed as a double-track line in 1833-1835, but only one track was laid; the second track was added about 1861. On section C-D of the accompanying drawing the original fill at the location in question is very clearly shown; it consists of a yellow clay with horizontal layers of red clay, which proves that the fill was built from the bottom in horizontal layers, presumably with the use of teams. Section C-D shows also the original longitudinal string pieces and a sleeper or cross-tie underneath. The original track construction consisted of cross-ties or sleepers spaced about 4 ft. apart, upon which rested longitudinal string pieces (measuring 6 x 6 in); upon the latter the flat iron rails were nailed. The sleepers were partly embedded in the natural ground, and were supported on ballast at both ends. The ballast was placed in excavated cavities, each containing about 1½ cu.ft. of broken stone.

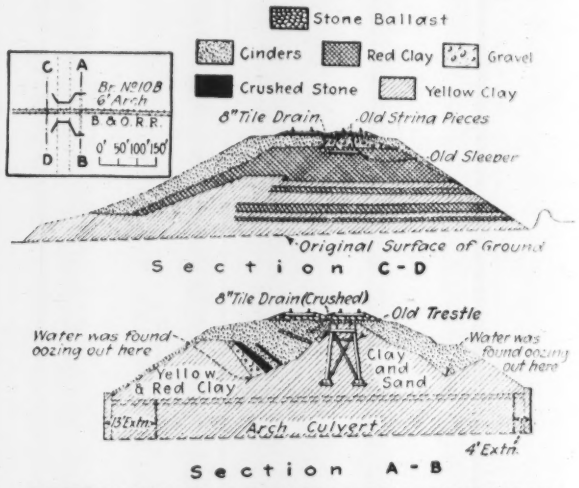
On Section A-B is shown a portion of the original trestle across the little stream. It appears that the fill was first built just high enough to cover the arch. The horizontal layers are clearly visible, but have not been shown on the section; they are extremely thin, probably to facilitate the tamping over the arch. On top of these horizontal layers of clay the trestle rested upon mud sills. It appears that the material was dumped in when the trestle was subsequently filled, since there is no evidence of horizontal lavers above the mud sill.

Trouble With Track Grade

For many years trouble was experienced in keeping the track up to grade at this place. Whether this goes back to the time when there was only a single track, or started after the second track was added, cannot be stated, but it is certain that the widening of the bank on account of the second track aggravated the trouble. This is very clearly evidenced by Section A-B, since the sliding of the alternate layers of gravel, crushed stone, cinders and the stone ballast has taken place on the side of the second track. It seems particularly clear that the presence of the gravel, which began to form a pocket, was the real cause of the trouble, since the red clay, shown by Section C-D, is holding up well. Even the red clay on the outside of the original fill for the second track is in fine condition and forms a solid bank together with the yellow clay. The cinders on the outside of the red clay have, however, caused trouble.

It appears that the base of the rail at present is 4 ft. higher than originally, and since the adding of ballast accounts for at least 18 in., the present subgrade at this place can be said to have been raised about 2 ft. On account of this raise, as well as on account of the greater width of the roadbed and track centers, it became necessary to increase the width of the bank. This was done with cinders and has not proved very satisfactory, since the rain water has readily sunk through the cinders and soaked the underlying clay. On Section C-D this situation is not quite as bad as on Section A-B, where it was aggravated by the presence of the pocket of gravel, etc., on the inside of the fill. The headwall of the culvert also had a retarding effect upon the run-off. This combination of causes has been keeping this part of the fill continually wet. During construction of the undergrade crossing a part of the bank slid and tore off a portion of the headwall of the culvert.

Various means have been tried to remedy conditions in this fill. In 1912 several cross-drains (1 ft. wide and 3½ ft. deep), built of one-man stones, were put in below subgrade, but did very little good. Some years previous, the 8-in. tile drain shown on Section C-D was put in. On Section A-B this pipe is shown as it was found when the section was measured; it was crushed and had slid down three feet.



SECTIONS THROUGH RAILROAD FILL ORIGINALLY PLACED IN 1833

From this examination the following conclusions as to railroad fills might be made:

Where the material is clay, or partly clay, the bank should be built in layers approximately horizontal.

It is important that the surface of the bank is sloped about 1 in 30 to make the rainwater run off. To be sure that this is really accomplished, the bank should become thoroughly settled before the track is laid.

If a clay bank is to be raised or widened, the same or similar material should be used. Particularly, cinders or gravel should be avoided where the original fill consists of clay, since both materials are pervious, and the clay will be continually wet where it is in contact with the cinders or gravel, and being covered will not dry out, as it would if it were exposed.

It is very important that the additional fill be allowed to settle thoroughly, and then it should be made certain that the surface of the new fill is sloped in exact continuation of the 1 in 30 slope of the old fill, being neither higher nor lower.

If a pocket has already been formed in an old fill, the

only way of curing the trouble is to remove the pocket and rebuild the fill in layers of the same material as used in the original fill, taking care that each layer is thoroughly compacted and given a slight slope (1 in 30) away from the center of the bank.

Unfortunately, with our present day methods, using steam shovels and filling from a construction trestle, it is hardly ever practicable to follow the method of construction outlined above, although, if it could be done, the additional cost would no doubt prove a paying investment.

Narrow-Gage Railway Operation at Munition Plant

Eight Miles of Industrial Track at Edgewood Arsenal Used to Transfer Shells Operated as a Regular Railway System

By James A. Silsbee
First Lieutenant, C. W. S., U. S. A., Edgewood Arsenal, Md.

NARROW-GAGE railways have a distinct value in large industrial plants. How one was built and operated during the war at the Edgewood Arsenal, near Baltimore, Md., may be of value to engineers contemplating the use of similar equipment.

On account of the peculiar layout of the buildings containing the shell-filling machinery at the arsenal, one of the important items in the operation was the system of conveying the shells from the standard gage railroad, through the filling process, and back to the standard gage again. Edgewood Arsenal is the place where the United States manufactured poison gas, put it in hollow steel shells, corked up the shells with steel "boosters" containing the explosive, and shipped the shells to France. This entire process was done by machinery.

The plant consisted of a chemical group of buildings where the gases were made, and three separate units where shells were filled, all separated by 1000 to 1500 ft. Two of these units consisted each of four long, narrow buildings arranged radially about a central compressor house. The shells were unloaded in boxes from standard-gage cars at any one of three long sheds or shell dumps. Here they had to be unpacked, fitted with boosters and conveyed to the filling buildings where they received their charge of poison and were sealed up, after which they had to be conveyed to another or outgoing shelldump to be painted, labeled, repacked in boxes and shipped to France.

For conveying the shells through this process and for hauling the chemicals from the chemical plant to the filling buildings, an extensive system of narrow-gage railroad was constructed. The track used was 16 lb. rail, 21½ in. outside gage. This track is built up at the factory with steel ties. The tangents are in 20-ft. lengths. The curves are all bent on a 12-ft. radius at the center of track, and are made in lengths varying from $\frac{1}{32}$ of a circle up to $\frac{5}{32}$, that is, there are curves the length of which are $\frac{1}{32}$, $\frac{2}{32}$, $\frac{3}{32}$, $\frac{4}{32}$, or $\frac{5}{32}$ of a circle, and these can be combined by suitable castings to make any desired length of curvature; $\frac{1}{32}$ gives a central angle of 11¼°, $\frac{8}{32}$ gives 90°, etc. The switches were all of cast iron and of four types, right hand, left hand, two way, and three way. The right hand and left hand were a combination of straight track and a $\frac{3}{32}$ curve to right or left. A combination of a right-hand switch and a $\frac{8}{32}$ curve would give a 90° turnout to the right from a tangent. A two-way switch consists of two $\frac{3}{32}$ curves in opposite directions producing a "Y". A three-way switch consists of two opposite $\frac{3}{32}$ curves with a straight track through the center producing a right and left turnout from a straight track at the same point. Cast-iron crossovers were also made up in angles corresponding to all the curves.

Owing to the soft soil, a combination of clay and sand with no gravel or stones, it was necessary to use 6 x 6 x 36-in. wood ties under the tracks in addition to the steel ties. These were spaced every 5 ft. under tangents and every 2½ ft. under curves. The switches were laid on 6 x 6 in. by 6-ft. wood ties. The entire system was ballasted with mixed medium and fine slag.

The cars were four-wheeled ball-bearing, outside flanged. There were flat cars of 2- and 5-ton capacity; shell cars of same capacity which consisted of flats fitted with steel racks for holding the shells standing on end; tank cars for hauling chemicals and steel dump cars for hauling cinders from the boiler room.

The motive power consisted of ten Hunt electric storage battery eight-drive wheel, chain-driven, and five Lakewood storage battery, eight-drive wheel, geared locomotives.

The general plan of the track layout was a main line from the empty shell dump to the inside end of the filler buildings, thence around the outside end of the filler buildings and to the full shell dump. A train of empty shells would start from the dump and leave a car of empty shells at the inside end of each filler building where the shells were put on a conveyor through the filling machines. At each building the train would pick up the empty cars which had previously been left, and as it came around to the outside ends of the buildings it would leave an empty car at each and pick up a car of full shells. When it had called at all four buildings in the unit, it would go to the full shell dump where the train was left and the locomotive was ready for the next trip with a new train. As there were three filling units, there were three railway systems of this sort, but all conveniently connected.

Operating Force Large

For construction, maintenance and operation, the personnel of the railroad consisted of about 150 enlisted soldiers and one first lieutenant. This force was divided up into train crews, yardmasters, dispatchers, switchmen, oilers, car repair men, riggers, store keepers and section gangs. The trains were operated 24 hours per day. Each crew consisted of a motorman, conductor and two trainmen. On the day shift for operation there were four train crews of four men each, and one yardmaster, one oiler, two car repair men, one switch man and one sergeant in charge of operation. The two night shifts consisted of three crews each, one yardmaster and one switchman. All told, about 50 men were assigned to the operation alone.

The trains were made up of from three or four to as many as 25 cars. A steel dump car loaded with sand or ballast or wet cinders would probably weigh four tons and the locomotive weighed five tons, so that loads of 100 tons were frequently hauled with a single locomotive. The maximum grade did not exceed 2 per cent.

In order to prevent waste of power and loss of time by stopping trains at junction points, a set of signals

was arranged. At one junction point in particular, trains went by bound for ten different destinations. The tracks were on long up grades in all directions from this point, and it would have cost considerable power, time and wear and tear to stop and start all trains on these grades. To prevent this each locomotive was provided with six round galvanized iron disks 10 in. in diameter, two of which were painted white, two green, and two red. Ten combinations of these were arranged, each train destination being assigned one combination, e.g., one white disk on an approaching locomotive meant it was going to the mustard gas plant, one red disk and one green meant the train was bound for the 75 mm. plant, one white and one red designated the chemical plant, etc.

For night work a small box containing an electric light was placed on each of the four corners of each locomotive. The side away from the locomotive consisted of three pieces of glass, one white, one red, one green. Shutters were arranged over the glass so that only the desired color need be shown. Keys to the signals were prepared consisting of 8 x 10-in. paper mounted or cardboard and shellacked, on which each combination was shown by a small picture of an approaching locomotive with signals in color. Each locomotive was furnished with one of these keys, as were also the switchmen stationed at the junctions. The switchman could tell where a train was bound while it was several hundred feet away. It was his duty to set all switches before the train arrived and to block all other trains necessary, so that through trains on down grade could pass at full speed without hesitation.

For maintenance the system was separated into five divisions. Each division had its own section foreman and gang consisting of about ten to twelve enlisted men each. No section gang was allowed to work outside of its own division. This system started a spirit of competition which resulted in some unusually excellent roadbeds. The entire maintenance work was under direct charge of a corporal who had had considerable experience on standard-gage work before his enlistment.

For construction work there were four gangs each consisting of a foreman and six or eight other soldiers. Steam shovels, teams, scrapers and dump wagons were also used at times, which were operated by civilians. The following list of quantities will give a fair idea of the magnitude of the construction work, and amount of rolling stock used in operation. The entire system was constructed during the summer of 1918.

Total embankment	12,000 cu.yd.
Total excavation	9,000 cu.yd.
Total ballast	6,228 cu.yd.
Total length of track over which a train could make a continuous trip	40,231 ft.
Total switches	239
Total length curves built up 12 ft. radius	2,707 ft.
Total 3-ft. ties	8,084
Total 6-ft. ties	1,185
Total fish plates	6,805
Total track bolts	13,610
Total spikes	37,034
Cars all kinds	481
Locomotives	15

The construction, maintenance and operation of this road was assigned to the Civil Engineering Department of Edgewood Plant, Edgewood Arsenal, of which Lieut. James E. Cuff, C. W. S., U. S. A., was in charge. The writer had entire charge of the 21½-in. gage railroad for Lieutenant Cuff, and was assisted by the non-commissioned officers and enlisted men assigned to the work.

Comparison of Road Subgrade and Air Temperatures

University of Illinois Erects Thermograph To Study Variations—Changes in Air Temperature Slow To Affect Subsoil

By C. C. Wiley

Associate in Civil Engineering, College of Civil Engineering, University of Illinois, Urbana

THERMOGRAPHIC measurements to study the variations in temperature between the atmosphere and the subsoil of hard-surface pavements have been inaugurated by the Department of Civil Engineering of the University of Illinois. While these studies have not gone far enough to warrant definite conclusions, they have shown that changes in temperature are transferred very slowly from the air to the subsoil, giving evidence of much less range, and that the extremes in the subgrade graphs lag somewhat behind those of the air graphs. The investigations were started in the belief that some of the phenomena of cracking and heaving of brick and concrete roads can be explained by a study of the range and rate of change in temperatures within the pavement and in the underlying soil. The observations will extend over a considerable period of time to obtain data concerning some of these factors.

The initial installation of equipment was made early in December, 1918, on a brick road about a mile outside the city of Champaign, Ill. This road was built by state aid in 1914, and consists of a brick pavement 10 ft. wide with earth shoulders of the same width on each

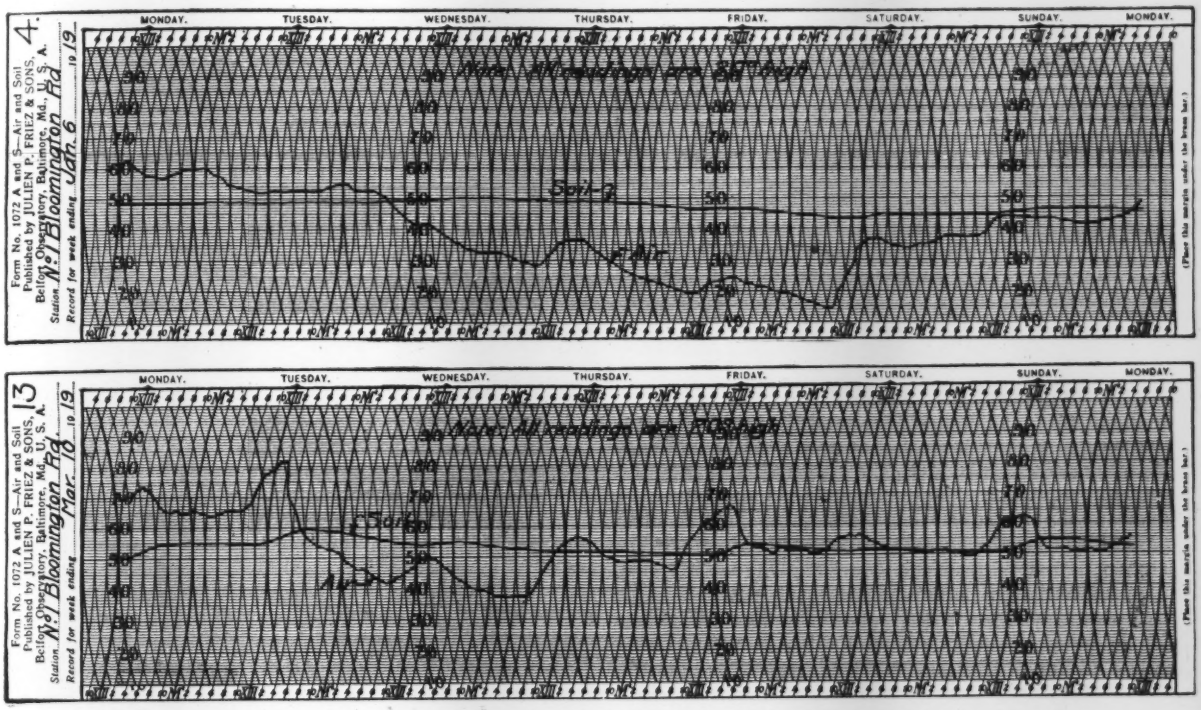
LOCATION AND CLOSE-UP VIEWS OF A SUBGRADE THERMOGRAPH STATION

side. The pavement is of the sand-cushion, grout-filler type made up of a 5-in. concrete base, a 1-in. sand cushion, and standard 4-in. paving block.

A point for observation was selected about 10 ft. from a small culvert, at the bottom of a slight sag, as being the most likely place to give maximum effects of freezing and thawings. The conditions are such that the ground water probably stands at a relatively high level, and the soil in contact with the pavement is frequently saturated. The soil is a rather heavy black loam for a depth of about 2 ft. below which is a heavy, gumbo-like clay.

The installation consists of a ventilated instrument house mounted on posts just outside the ditch line and containing a double soil thermograph, the general arrangements of which are shown in the illustration. An ordinary thermometer and a maximum and minimum thermometer are also used to check the recording instrument. The thermograph is the same as used by the

United States Agricultural Experiment Stations and is made by Julian P. Friez & Sons of Baltimore. One bulb of this instrument is suspended in the center of the instrument house to record the air temperatures, while the other is carried through a 1¼-in. iron pipe to a point under the center of the pavement slab, and in contact with the lower surface of the concrete base.



TEMPERATURE GRAPHS OF FROZEN AND UNFROZEN SUBSOILS OVER SEVEN-DAY PERIODS

There is thus obtained a continuous graphical record of the temperatures both of the air and of the soil immediately under the pavement.

Additional equipment will be added in the near future, so arranged as to give records of the temperature at the surface, at mid-depth of the slab and, possibly, in the soil at varying distances from the center to the edge of the slab. Provision will also be made to measure the elevation of the ground water, and changes in elevation of the slab from time to time. The data obtained will be combined with those of the local weather station and the soil temperatures of the agricultural experiment station, and is expected that some interesting and valuable information will be obtained.

Two of the thermograph charts are here reproduced. These were chosen to show several points which seem to be characteristic of the temperature curves.

Chart No. 4, for the week which ended Jan. 6, 1919, shows the period of extreme cold for the winter which, as a whole, was extremely mild. It ill be noted that with three consecutive days of low temperature with a minimum of —6° F. the temperature under the pavement (where the soil had been frozen by cold weather of the preceding week) dropped only 6° and immediately began to rise when the air temperature passed the low point. It was characteristic of charts taken where the ground was frozen to show little variation due to air temperature changes.

In contrast with this, note that Chart No. 13, for the week which ended Mar. 10, 1919, when the frost had gone out of the ground, shows fluctuations in the soil temperatures parallel to those of the air, even for small daily ranges in the air temperatures. It will be noted, however, that the soil temperatures lag several hours behind those in the air and are very much smaller in magnitude.

The fact that the changes of temperature at the bottom of the slab are considerably slower and much less in magnitude than those of the air may be worth considering in connection with protecting a new pavement from freezing. Also, it may be noted that the change from maximum to minimum temperatures in the slab take place over a considerable length of time, during which the slab and subgrade have an opportunity to adjust themselves to the changed conditions. When the data are more complete and combined with other facts available, it should be possible to determine with fair certainty some critical points in pavement design which now are little more than guessed at.

Cement Production Fell Off In 1918

Complete statistics of the output of cement in 1918 indicate a marked decrease from the output in 1917, and show that the production of portland and other cements in 1918 was the lowest since 1909. The final statistics of shipments, production and stocks are about 1% lower than those given in the United States Geological Survey's preliminary estimate, published in January. The shipments of portland cement in 1918 amounted to 70,915,508 bbl., valued at $113,153,513, compared with 90,703,474, valued at $122,775,088, in 1917, a decrease in quantity of 21.8% and in value of 7.8%. The production in 1918 was 71,081,663 bbl., compared with 92,814,202 in 1917, a decrease of 23.4%. Stocks in the mills increased from 10,353,838 bbl. in 1917 to 10,453,950.

Pressing Out Mix Water Adds To Cement Mortar Strength

Tests Made With Special Apparatus Permitting Pressures Up to 30,000 Pounds Per Square Inch Give Very High Compressive Values

By C. T. Wiskocil
Assistant Professor of Civil Engineering, University of California, Berkeley, Calif.

EXCEPTIONALLY high strengths of cement mortar have recently been obtained in a series of tests conducted by the writer, in which was used a special apparatus designed to subject the specimen to an extremely high pressure which squeezes out or expresses much of the water of mixing. A controlling detail in the apparatus is the use of a perforated mold which permits the escape of the expressed water. The results seem to be of importance, particularly in the development of cast concrete products.

The maximum strength of the combination of any aggregate, cement and water can be secured only by reducing the voids to a minimum. Pore spaces are caused by air entrapped during the mixing and all water which does not combine chemically with the cement. Any attempt to reduce these voids must necessarily be made before the cement sets.

Tamping dry concrete improves its strength by reducing the air voids. (See H. Burchartz, "The Influence of Tamping on the Strength of Concrete," *Engineering Record* of Sept. 22, 1906, p. 332.) Compacting it in layers under pressure accomplishes the same results; the actual increase, according to experiments by F. P. McKibben, noted in *Engineering News-Record* of Dec. 5, 1918, p. 1031, may be as much as 51 per cent.

With wet concrete, which inherently has fewer air voids, tamping is not so effective. Nevertheless, it is employed to force the concrete into all corners of the forms, or the forms may be vibrated by hammer blows to secure similar results. These methods do not affect the homogeneity of the concrete. The finishing of concrete road surfaces with rollers will, however, improve the strength of the hardened concrete when wet mixes are used. Experimental slabs made by this method were increased 10% in strength, indicating that the water voids had been decreased. (See A. N. Johnson, "Tests of Concrete to Determine the Effect of Removing Excess Water Used in Mixing," "Proceedings," A. S. T. M., Vol. XVII, Part II, p. 379.)

Water cannot be effectively removed from fluid mixes by rolling; it must be expressed or squeezed out by applying pressure to confined masses. By such methods the water and air voids can be reduced to a practical minimum. It is evident, however, that water cannot be squeezed out of concrete after it has been placed in forms for monolithic construction. But, inasmuch as precast concrete made in the usual way from wet mixes is coming into such wide use, and since pressure methods are already in use for producing precast shapes from dry concrete and mortar mixes, a study of the possible improvement in strength by a positive method of decreasing the air and water voids seemed warranted. Such an investigation was started in 1917 in the Materials Testing Laboratory of the Department of Civil Engineering of the University of California.

The chief difficulty encountered in the investigation was the construction of a mold or container in which the fresh mortar could be compressed. The mold used as shown in the accompanying drawing, was made entirely of steel. It is a hollow cylinder, with a solid plunger in each end. The space between the plungers, which fit perfectly the interior of the cylinder, forms the pressure chamber. The cylinder is essentially in two parts, an outer shell and a tapered lining in four sections, all of which are perforated with small holes terminating in longitudinal grooves in its outer surface. The grooves permit the escape of the water forced out of the pressure chamber.

The materials used were Santa Cruz portland cement from Davenport, Calif., and a poorly graded sand containing considerable mica. All of the sand passed a No. 10 sieve. The amounts, by weight, retained on other sieves were as follows: One per cent. on a No. 20,

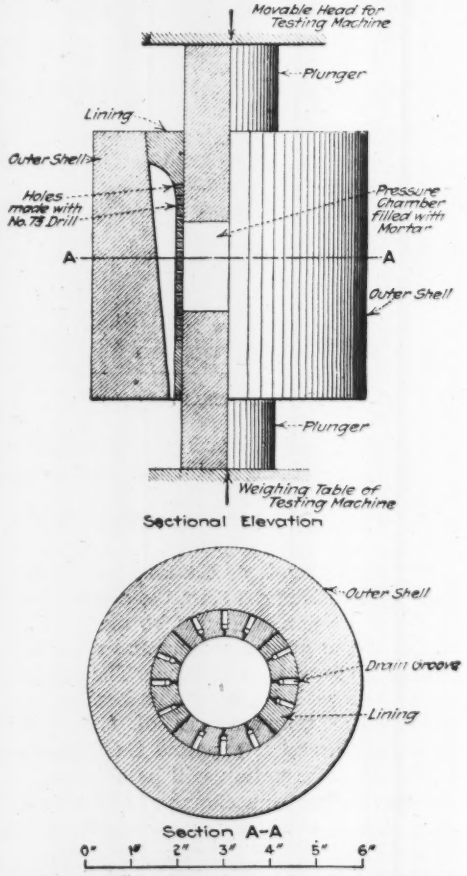


FIG. 1. TEST APPARATUS TO PRESS OUT WATER FROM CONCRETE MORTAR SPECIMEN

3% on a No. 30, and only 14% on a No. 40 sieve. Its weight was 93 lb. per cubic foot while the percentage of voids and specific gravity were 43% and 2.67, respectively.

In molding a specimen, the applied pressure was immediately released when it had reached the predetermined amount. The lining of the mold was slipped out and lifted apart to free the hard cylinder of fresh mortar, which was then placed in a standard moist

closet to cure. The control specimens, which were made without pressure, were removed from their molds 48 hours after being cast and then stored with the pressure specimens.

The first group of specimens was made to study the effect of expressing the water from various cement and sand mixes which ranged from neat to 1 : 5 by weight Six specimens were made from each batch, three without pressure in 2 by 4-in. cylindrical molds, as controls, and three were molded under pressure. The latter were 2 in. in diameter and approximately 4 in. long. The percentage of mixing water, on the basis of dry materials, was the same for each mixture, namely, 25%, by weight.

In the second series the mix, one part cement to four parts sand, was kept constant, and the amount of water expressed was varied. Each batch was mixed with 24% water, by weight of cement plus sand, yielding sufficient mortar for six specimens, three of which were molded in 2-in. cubes as controls. The three pressure specimens were 2 in. in diameter and about 2 in. long.

The effect of expressing part of the mixing water can be clearly seen in the results of the first series, as shown graphically in Fig. 2 and in detail in Table I. The greater percentage increase in the strength of the lean mixes was caused by the higher relative water content of the mortar as based on the amount of cement used. The stiffer consistency of the richer mixes produced relatively greater strengths in the controls and lower strengths in the pressure specimens.

TABLE I. VARIOUS MORTARS, CONSTANT PRESSURES

(Showing percentage changes in various properties of mortars as affected by expressing the mixing water under constant pressure, 19,000 lb. per sq. in., series 1.)

Mix	Strength, Lb. per Sq.In. Specimens 7 Days Old Controls	Pressure	Percentage Increase Strength	Solidity	Weight	Percentage Decrease Water Content
1:5	194	1,070	451	38	9	78
1:4	242	1,757	626	30	14	68
1:3	597	2,520	322	28	12	70
1:2	1,170	4,240	262	23	13	72
1:1	2,370	6,930	192	28	15	68
Neat	6,870	14,230	110	40	20	76
Neat*	2,530	17,080	575	56	27	77

* Pressure 30,000 lb. per sq.in.

The neat controls weighed 124 lb. per cu.ft. which was increased to 158 lb. per cu.ft. by pressure. The corresponding change in solidity was from .493 to .768.

This explanation was verified by making a special batch of neat cement mortar with 37.25% water by weight of cement. Pressure specimens made from this mixture were 6¾ times stronger than the controls. The molding pressure, 30,000 lb. per square inch, thus produced an increase of 575% in the compressive strength. The average strength of the pressure specimens made from mortar mixed with 25% water was 14,230 lb. per square inch. Pressure specimens made from the wetter mortar averaged 17,080 lb. per square inch. The greatest strength obtained, 18,360 lb. per square inch, is quite remarkable 7-day strength even for neat cement. The strength of ordinary 2-in. cubes of neat cement one year old will not exceed 14,000 lb. per square inch.

Increasing the amount of water expressed has a decided effect on the strength, especially at the lower pressure. At 10,000 lb. per square inch the percentage increase in strength is about 570%, while the maximum pressure (30,000 ib. per square inch) raises this percentage increase to 810. These relations for a 1:4 mix are indicated in Table II. It should be remembered that all pressure applied by the plungers is not transmitted throughout the mortar, because of the high friction on the mortar against the inside of the cylinder while the water is being squeezed out. Also, the diameter of the plunger is increased at the high molding pressures, thus producing a further loss in applied force. No attempt has been made to estimate these frictional losses, hence the actual pressures available for expressing the water are not known. The curve in Fig. 3, in which nominal molding pressure is used, is consequently flatter for the higher pressures.

It is interesting to note that the 810% increase in strength is accompanied by only 17% increase in weight.

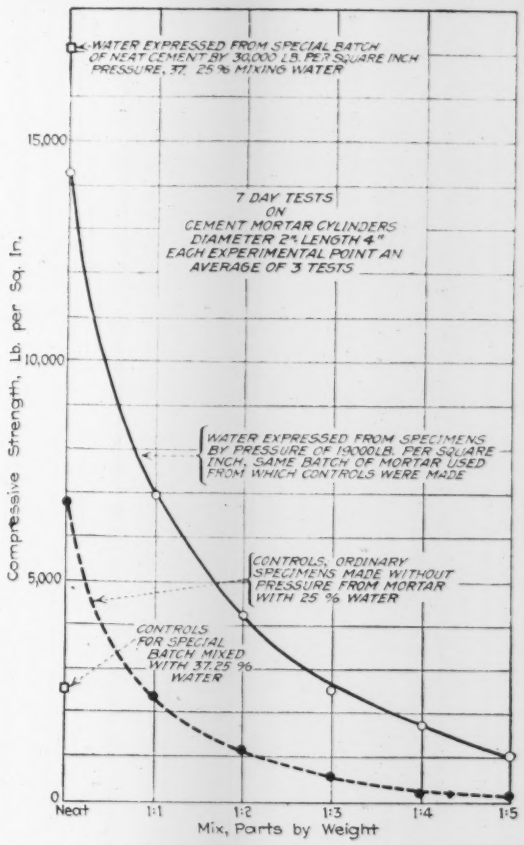

WATER EXPRESSED FROM SPECIAL BATCH OF NEAT CEMENT BY 30,000 LB. PER SQUARE INCH PRESSURE, 37. 25 % MIXING WATER
7 DAY TESTS ON CEMENT MORTAR CYLINDERS DIAMETER 2" LENGTH 4" EACH EXPERIMENTAL POINT AN AVERAGE OF 3 TESTS
WATER EXPRESSED FROM SPECIMENS BY PRESSURE OF 19000LB. PER SQUARE INCH, SAME BATCH OF MORTAR USED FROM WHICH CONTROLS WERE MADE
CONTROLS, ORDINARY SPECIMENS MADE WITHOUT PRESSURE FROM MORTAR WITH 25 % WATER
CONTROLS FOR SPECIAL BATCH MIXED WITH 37.25 % WATER
Compressive Strength, Lb. per Sq. In.
15,000
10,000
5,000
0
Neat
1:1
1:2
1:3
1:4
1:5
Mix, Parts by Weight

FIG. 2. STRENGTH OF VARIOUS CEMENT MORTARS AS INFLUENCED BY EXPRESSING MIXING WATER

TABLE II. CONSTANT MORTAR, VARYING PRESSURES

Showing percentage changes in various properties of 1:4 mortar as affected by expressing water under varying pressures, Series 2.

Molding Pressure Pounds per Square Inch	Compressive Strength Pounds per Square Inch	Percentage Increase Strength	Solidity	Weight	Volume	Percentage Decrease Water Content When Molded
1,600	1,080	237	16	6	16	41
3,180	1,280	300	20	10	19	50
5,000	1,680	425	24	10	21	56
6,370	1,800	463	26	12	22	61
10,000	2,250	603	28	13	24	59
12,700	2,310	622	30	13	25	67
15,000	2,400	650	31	14	26	65
20,000	2,650	728	33	15	26	68
25,000	2,710	747	34	15	27	74
25,500	2,730	753	36	16	27	73
30,000	2,910	810	36	17	28	73

The properties of 28 control specimens, nine different batches, from which the above values were computed, were as follows: Molding pressure 0, solidity .602, weight when tested 126 lb. per cu.ft., water content 24%, and pressive strength 320 lb. per sq.in. All controls were 2-in. cubes.

All pressure specimens were two inches in diameter and about two inches long.

All specimens were tested seven days after being molded.

In spite of the loss in cement which is carried in suspension by the expressed water, and the unequal distribution of molding pressure throughout the mortar specimens, the strength of 1:4 mortar molded under the highest pressure was 2910 lb. per square inch. This is 12.2 times stronger than the same mortar which was allowed to set and harden under the usual conditions indicated by the controls.

Pressure machines used in the molding of sand-lime bricks exert a force of 20,000 lb. per square inch on the face of the brick. Similar methods could be adapted to the production of precast cement mortar products in which the pressure used to express the mixing water

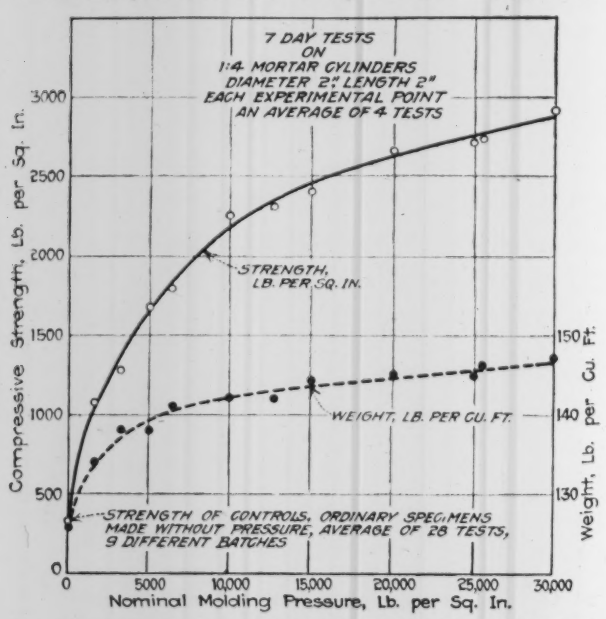


FIG. 3. EFFECT OF EXPRESSING MIXING WATER UNDER DIFFERENT PRESSURES; 1:4 MORTAR

from the mortar would increase its solidity by reducing both the air and water voids. In addition to improving the strength of the hardened mortar this process would insure exact dimensions, perfect faces and sharp edges on the finished product. Furthermore, with pressure-molding the rate of manufacturing any precast cement product would be greater than by methods now in use.

Maximum Sounding in Trinidad Asphalt Lake

Recent borings made in the asphalt lake on the Island of Trinidad have reached a new low level record of 150 ft. The previous record, made in 1893, was 135 ft. On both occasions the asphalt was found to be of uniform character throughout. Great difficulties attend any attempt to sound the lake, as it is in constant although almost imperceptible motion. The pressure of the mass of asphalt against the drilling apparatus causes it to bend, and the deflection makes further boring impossible. After completion of the test, the hole was observed to shift at the surface 25 ft. in six weeks. The movement was shown to exist to a depth of 100 ft., and there was evidence that the direction was reversed at a depth of from 25 to 50 ft. The movement of the asphalt is believed to be similar in many respects to the ascending and descending currents in a kettle of boiling water.

Properties of Malleable Cast Iron

Paper Read Before American Society for Testing Materials Gives Strength Data Obtained From Tests of Commercial Specimens of Material

WORKING data on commercial specimens of malleable cast iron were summarized by H. A. Schwartz, of the National Malleable Casting Co., in a paper presented before the American Society For Testing Materials, at the recent Atlantic City meeting. These data were obtained through extensive series of tests conducted by the company named. They apply to material of commercial character, passing the specifications of the American Society for Testing Materials, and not of selected superior quality, though known to be free from effects such as shrink holes or blow holes. In

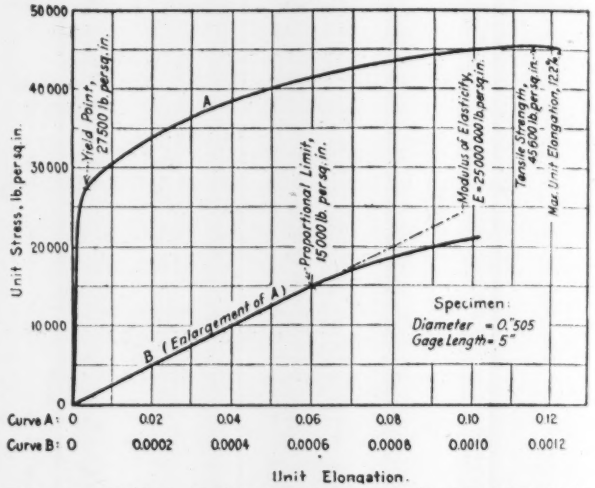


FIG. 1. TYPICAL TENSILE CURVE OF MALLEABLE CAST IRON SHOWS GOOD ELASTIC QUALITIES

certain cases the test specimens were machined to size (after annealing) or ground (before annealing), but it does not appear that the results differ very greatly from those which would have been obtained with material not finished by a mechanical process. Detailed studies of the relation between chemical composition and tensile strength, for many thousands of heats, are stated to have shown that the amount and form of the

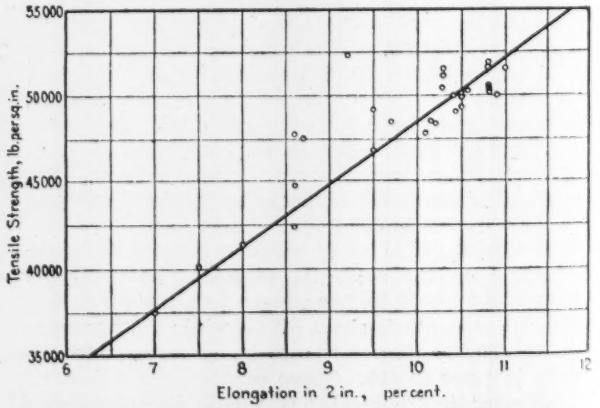


FIG. 2. INCREASE OF ELONGATION WITH TENSILE STRENGTH CHARACTERISTIC OF MALLEABLE CAST IRON (PLOT SUMMARIZES 840 HEATS)

free carbon present in the finished piece is the determining factor of quality; satisfactory commerical practice limits the composition so as virtually to eliminate variation due to the composition of the ferrite.

Tensile Strength—The standard tensile strength now specified is 45,000 lb. per square inch, with elongation 7½% in 2 in. The probable actual average of commercial material is 48,000 to 50,000 lb. per square inch, with elongation in 2 in. of 10 to 15%. Fig. 1 reproduces a typical stress strain diagram recorded by Prof. H. A. Thomas (but elongation measured on 5 in.). This piece was machined from a large block, 4½ x 9 x 14 in., and yet shows very satisfactory qualities. A set of tests on material rather better than the regular commerical run, on specimens cast to test size and ground before annealing, showed tensile strength ranging from 55,100 to 55,200 lb. per square inch, elongation (in 2 in.) from 13 to 19%, and reduction in area from 18 to 23 per cent.

Elongation Increases with Strength—Tests of specimens taken from 340 heats summarized in Fig. 2, bring out the striking peculiarity of malleable cast iron, that elongation increases with tensile strength. The relationship is not considered absolutely quantitative, yet is a general characteristic.

Compressive Strength—The elastic properties in tension and in compression are believed to be approxi-

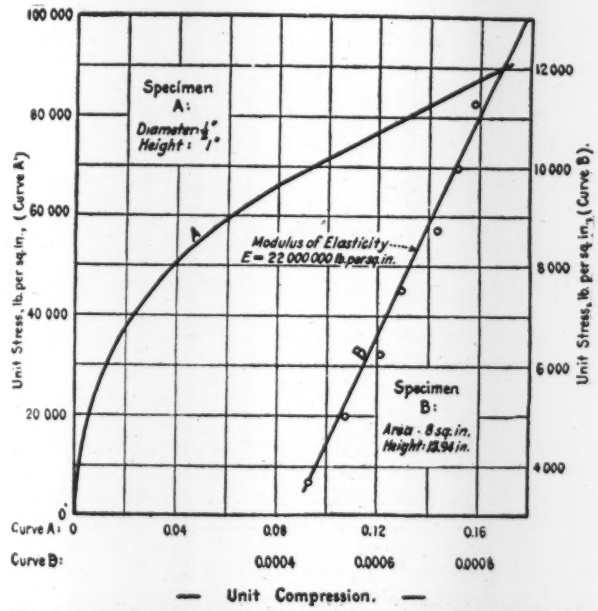


FIG. 3. CURVES FOR TWO COMPRESSION TESTS ON SMALL AND LARGE SPECIMENS

mately the same. Two compressive tests are plotted in Fig. 3. The curved line, for a small specimen, has a proportional limit of about 15,000 lb. per square inch; the large specimen (curve B) has a proportional limit exceeding 12,500 lb. per square inch.

In tests on specimens ⅝ in. in diameter by 10.6 in. long, acting as square-end columns, a straight-line stress strain curve was obtained up to a loading of about 25,000 lb. per square inch.

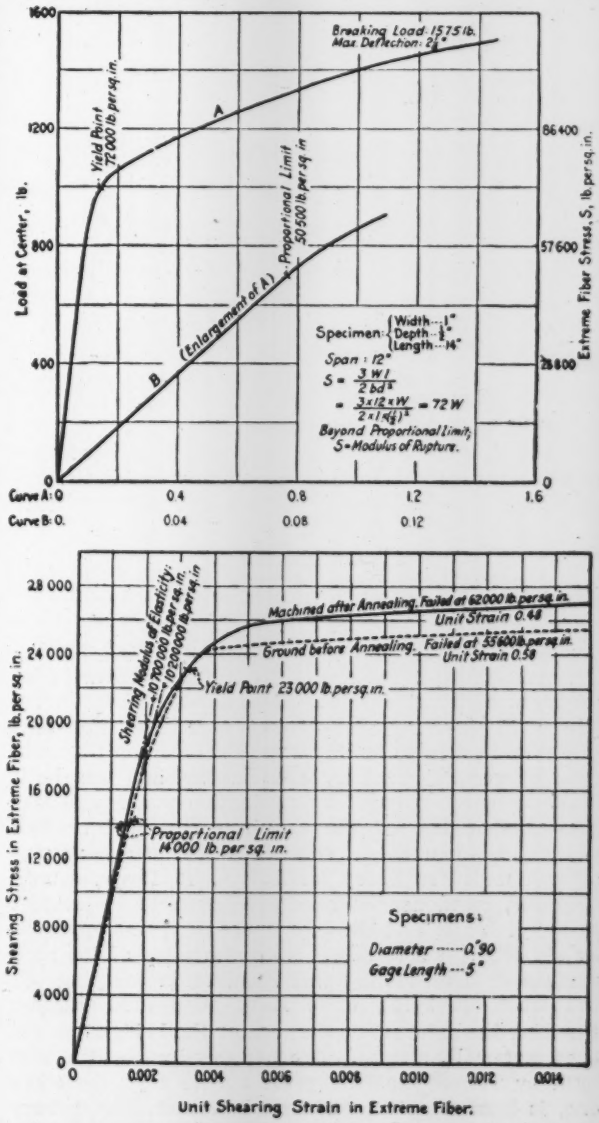
Cross-Bending Strength—Material that passes the A.S.T.M. tensile test specifications always displays a cross-bending strength corresponding to a modulus of rupture above 64,000 lb. per square inch. The figure named is roughly that represented by the cross-bending test requirements of the United States Railway Administration specification R-17 of May 1, 1918.

A typical cross-bending diagram for an unmachined specimen ½ x 1 x 14 in. loaded at the center of a 12-in. span is shown in Fig. 4.

Shearing Strength—Slightly different results were obtained in three different tests, one by punching a 1-in. round hole through a ½-in. plate (unmachined), one by applying double shear to a ⅞-in. pin (machined after annealing), and the third by the same double-shear test on a pin ground to size before annealing. The ultimate shear values in pounds per square inch for these three tests were: 45,152, 40,340 and 41,350.

Similar slight differences between ground and machined specimens were found in torsion tests, but here the machined specimens showed the higher strength, 62,000 lb. per square inch against 55,600.

Other Properties—Brinell hardness of malleable cast


Breaking Load 1575 lb.
Max. Deflection 2"
Yield Point 32 000 lb. per sq. in.
Proportional Limit 30 500 lb. per sq. in.
(Enlargement of A)
Specimen: Width 1" Depth ½" Length 14"
Span : 12"
Load at Center, lb.
Extreme Fiber Stress, S, lb. per sq. in.
Curve A:
Curve B:
Machined after Annealing. Failed at 62000 lb. per sq. in.
Unit Strain 0.48
Ground before Annealing. Failed at 55600 lb. per sq. in.
Unit Strain 0.58
Yield Point 23 000 lb. per sq. in.
Proportional Limit 14 000 lb. per sq. in.
Specimens:
Diameter .90"
Gage Length 5"
Shearing Stress in Extreme Fiber, lb. per sq. in.
Unit Shearing Strain in Extreme Fiber.

FIGS. 4 AND 5. GRAPHICAL RECORDS OF CROSS-BENDING AND TORSION TESTS (BENDING SPECIMENS UNMACHINED, TORSION SPECIMENS FINISHED BY TWO METHODS)

iron ranges from 101 to 145 (110 average). Material with a hardness of 102 gives Shore scleroscope readings of about 15. The Brinell number varied approximately with tensible strength and inversely with carbon content.

Maximum flux density in magnetization tests, about 12,000; maximum permeability, about 2,300. Specific

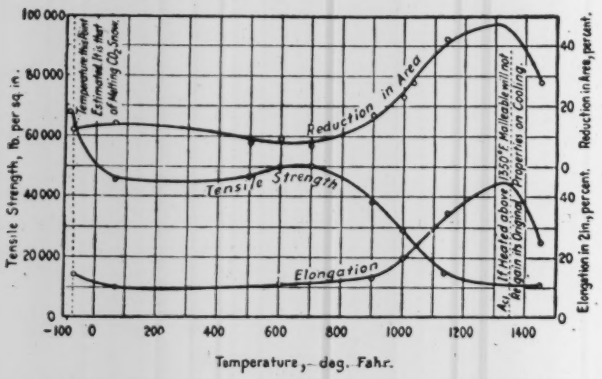

Tensile Strength, lb. per sq. in.
Reduction in Area, percent.
Elongation in 2 in., percent.
Temperature, deg. Fahr.
Reduction in Area
Tensile Strength
Elongation
Temperature that Estimated this Part of Melting Co. Scale
If Heated above 1350° F. Malleable will not Regain its Original Properties on Cooling.

FIG. 6. EFFECT OF TEMPERATURE ON TENSILE STRENGTH AND DUCTILITY OF MALLEABLE CAST IRON

resistance (one average sample), 0.000041 ohms per centimeter cube at 75° F. Density before annealing about 7.7, after annealing about 7.35, ranging from 7.45 to 7.25 as the carbon percentage is increased from 2.3 to 3.2. Thermal expansion coefficient is approximately $1 + 0.000006\ t + 0.0000000125\ t^2$, where t is the temperature in degrees Centigrade. This curve fits the observed values between 0 and 1100° F. very closely.

The first critical point of malleable cast iron is not materially different from that of hard iron, or about 1350° F. (732.5° C.) for the heating curve and 1280° F. (693.5° C.) for the cooling curve.

Strength and ductility are affected by temperature at a lower value. The results are summarized in the diagram, Fig. 5, which refers to tests on specimens 0.634 in. in diameter ground to size before annealing.

Historical Cast-Iron Bridges Jacketed with Concrete

Two very old cast-iron bridges in Shropshire, England, dating from the time of Thomas Telford, are being made safe for modern heavy traffic by concrete incasement of the main ribs. Recent news given in the *Times Engineering Supplement* says that the first bridge to be treated in this way is situated on the main road between Shrewsbury and Ludlow, and was built 95 years ago. A careful examination made last year showed that two of the cast-iron ribs had cracked badly at the haunches. The bridge had long been considered unfit for heavy traffic. A. T. Davis, county surveyor, recommended reinforced-concrete incasement of the arch ribs and the recommendation was approved by the county authorities. No disturbance of the road surface or hand railing was required in carrying out the work, it being done from suspended staging. Further, the external appearance of the bridge has not been materially altered. Another cast-iron bridge, also built by Telford, but five years earlier than the other one, is located on the main road between Shrewsbury and Wenlock. This bridge is also inadequate for modern traffic and the same strengthening procedure is to be applied to it.

Tests of Thin-Base Monolithic-Brick Road

By Harlan H. Edwards
Highway Engineer, Urbana, Ill.

THIN-BASE monolithic-brick pavements have been proved a success by recent investigation of such construction in Illinois. Practice has proven correct the conclusions drawn from tests made at the highway laboratory of the University of Illinois three years ago, (described in *Engineering Record* of Jan. 15, 1916, p. 86 and in *Engineering News-Record* of Nov. 1, 1917, p. 820) and from an experimental road near Danville, Ill., described in *Engineering Record* of Sept. 30, 1916, p. 400. These experiments showed that a monolithic-brick slab was as strong as or stronger than a 1:2:3 gravel-concrete of the same thickness; in fact, that the monolithic-brick slab was in effect but a two-course concrete slab having an extremely coarse aggregate (paving brick) in its wearing surface in place of a granite or traprock topping.

A monolithic-brick pavement three years old having a very thin layer of concrete for the lower portion has been examined recently and found in perfect condition. This road, which was built by Stockland Township, Iroquois County, Ill., in 1916, was made of 4-in. wire-cut lug brick laid and grouted on a 1-in. layer of 1:2½:4

ROAD IN STOCKLAND TOWNSHIP, ILL., AFTER NEARLY THREE YEARS OF SERVICE

concrete, using roofing gravel for the coarse aggregate. There were 6½ miles of this pavement, in which the slab was 9 ft. wide, with 8-ft. earth shoulders on each side, costing in all $8500 per mile. Many different kinds of soil—brown-silt loam, black loam, timber soil, clay, sand and gravel—were encountered. In all these soils, however, good drainage was provided for the road, thus enabling the thin slab to carry the heavy loads. The road has been used through three winters, and is in perfect condition, with no longitudinal cracks. Over it grain and other agricultural products are hauled to town, and coal and other heavy supplies returned, providing a medium-heavy traffic. The traffic and condition of the surface are shown in the illustration.

Considering this experience as well as many others of this general type, it would seem that the thin-base monolithic pavement has a place in our road designs, and that it should not be discriminated against, as seems to be the custom, by the requirement that the thickness of slab shall be from 20 to 35% greater than the beam acting portions of other types. Engineers now seem to be going to extremes in proportioning the thickness of slab in pavement construction, and are neglecting the

most essential feature of good roadbuilding—effective subdrainage and good surface. In many places a little more expense incurred in tiling and ditching to keep the sub-grade, which finally must carry the load, in a dry condition, would provide a foundation which could withstand much heavier loads at all times, and thus permit a thinner slab to support the traffic and take the wear.

Swimming Tank On Third Floor of Concrete Building

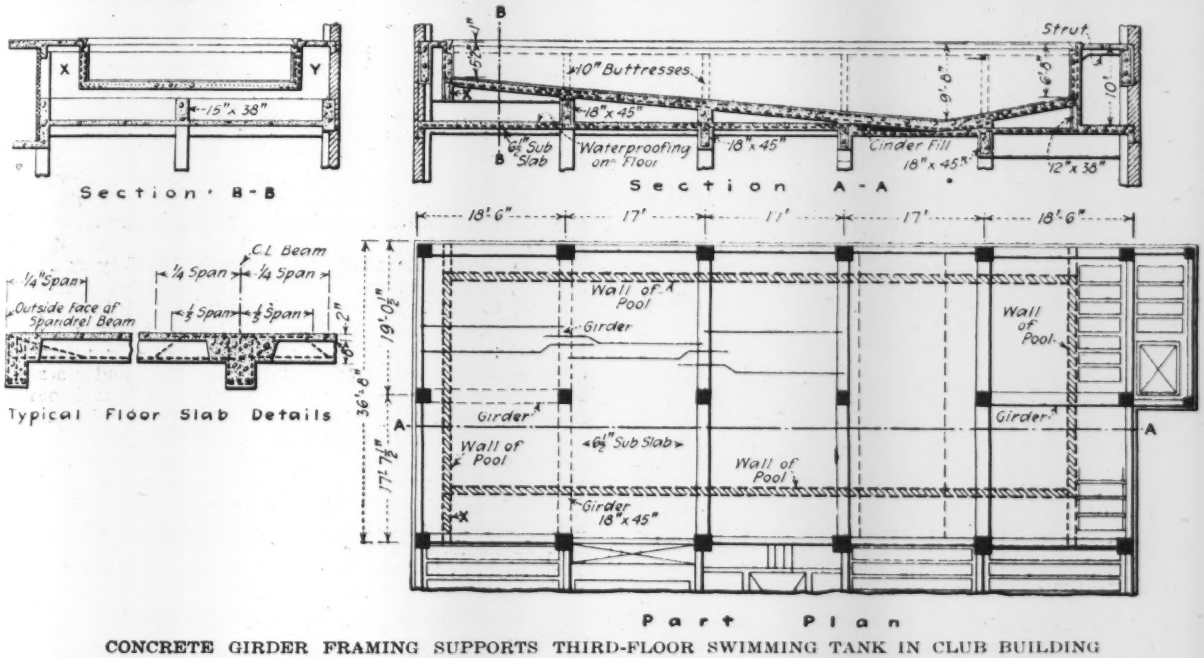
Deflection Limited to Avoid Cracks—Long Girders Carrying Columns Have Horizontal Spiral Reinforcement

BY L. R. VITERBO
Of Brussel & Viterbo, Consulting Engineers, St. Louis, Mo.

A 120,000-GALLON swimming pool, 27 x 76 ft., on the third floor of the new eight-story, reinforced-concrete building of the Omaha Athletic Club, Omaha, Neb., necessitated unusual construction for the support of the tank and the support of the floors above it. This location was selected because it is within easy reach of the gymnasium and locker rooms, and all available space at some special points. Spread footings of reinforced-concrete on good yellow clay soil form the foundations. For those footings which support the swimming tank the load per square foot of base is limited to 3500 pounds.

The concrete tank is an integral part of the structural framing. Transverse girders 18 x 45 in. at the mezzanine floor below the third floor support the inclined bottom slab of the pool, which is 12 to 14 in. thick. The 12-in. walls are reinforced as cantilever slabs to resist the full hydrostatic pressure. As an extra precaution, vertical reinforcement was placed near the outer faces of these walls, thus making them act as supported slabs, designed for half the full water pressure. These slabs have a bearing on the bottom of the pool and on horizontal beams formed in the top rim, the beams bearing against buttresses or horizontal struts which deliver the thrust directly into the columns.

Waterproofing of the floor and sides of the tank is provided for by using a rich concrete mix of 1:1½:3 with hydrated lime in the proportion of 10% of the weight of the cement. The pool is lined with three



CONCRETE GIRDER FRAMING SUPPORTS THIRD-FLOOR SWIMMING TANK IN CLUB BUILDING

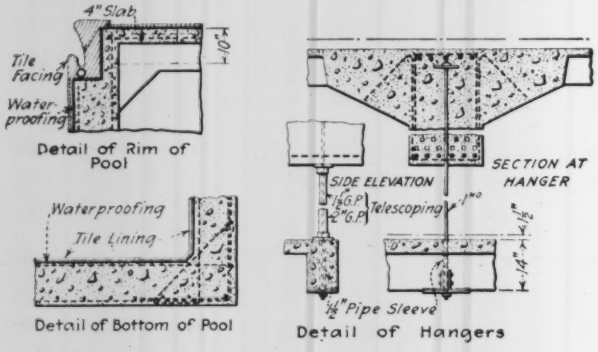
in the basement had been appropriated. As one row of interior columns is stopped at the third-floor level on account of the tank, the fifth floor is supported over the swimming room by heavy girders upon which are seated columns for the upper floors and roof, while hanger rods in these girders support the outer edge of a 4½-ft. balcony around the room at the fourth-floor level. The depth of water in the pool is from 5 to 11 feet.

The building is about 132 x 118 ft. in plan, with eight floors and basement, together with two mezzanine floors beneath the third and fourth floors. The columns and footings are designed to carry two additional stories. Normal column spacing is about 17 x 15 ft., with corner panels 18½ x 16¾ ft. Girders run only in the longer direction of the building, except in the end walls and layers of asphalt and has a facing of ceramic tile. Severe tests of the structural and waterproofing features gave satisfactory results.

With the pool full the capacity is 120,000 gallons, giving an estimated weight of 500 tons. The bottom of the pool was designed to carry this load, 320 to 600 lb. per square foot according to depth, together with all dead load and an evenly distributed live load of 100 lb. per square foot. This live load represents the load superimposed by the swimmers in the pool and the waterproofing and tile finish on the bottom. In designing the members an extreme fiber stress of 700 lb. per square inch was allowed in the concrete and 18,000 in the steel high elastic limit. It was aimed to limit the deflection to 1/600 of the span for girders and slabs supporting the tank, since deflections which might be of no im-

portance in an ordinary floor might tend to crack a tank bottom and cause leakage.

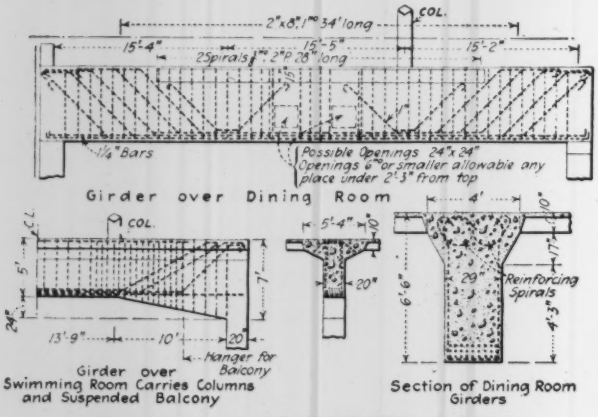
Girders at the fifth floor span the clear width of the swimming room, 33 ft. 9 in., and support two rows of columns for the upper floors and roof, besides carrying a suspended balcony around the swimming room. These girders are 29 in. thick, with a depth of 5 ft. at the middle and 7 ft. at the ends. In each end of each of



DETAILS OF CONCRETE SWIMMING TANK AND SUSPENDED BALCONY

these girders is embedded a 1-in. hanger road 13 ft. long, whose lower end carries a bearing plate or seat for a longitudinal girder forming the edge of a balcony slab, as shown in one of the detail drawings. The other side of the slab is supported by a wall girder. This balcony is designed for a live load of 100 lb. per square inch.

Girders with horizontal spiral reinforcement are used in the fifth-floor framing to support the floors over the



DETAILS OF LARGE CONCRETE GIRDERS

dining room. Each girder carries two intermediate columns for the upper portion of the structure. These girders are of 46 ft. span, 6½ ft. deep and 29 in. thick, the thickness being increased to 48 in. at the top to form a tapering flange, as shown in one of the accompanying drawings. In the compression zone of the top of the girder are two horizontal spirals 28 ft. long which provide for the very high compressive stresses. Part of the dining-room floor is carried by a pair of 46 ft. girders 23 x 48 in. in section.

John Latenser & Son, Omaha, were the architects, with Brussel & Viterbo, Chicago and St. Louis, as designing and consulting engineers for the structural features. The general contractor was the Selden-Breck Construction Co., St. Louis, Mo.

It may be noted that a swimming pool on the 10th floor is a feature of the Union League Club, Chicago. This has a steel tank, 30 x 60 ft., supported on steel columns independent of the columns of the building, the tank being incorporated in a three-story addition to the original height of the building. This was described in *Engineering News* of Jan. 11, 1917, p. 56

To Better Philadelphia City Government

THE enforcement of Philadelphia city contracts, the prosecution and punishment of the violators of any such contracts or of peculators of city funds, the investigation of municipal affairs, the dissemination of information designed to improve the government of the city, and the furtherance of measures for the immediate improvement of the bookkeeping and accounting of the city are the specific objects to which the income from the residuary estate of Thomas Skelton Harrrison of Philadelphia is to be devoted under the will noted in *Engineering News-Record*, June 5, 1919, p. 1132. The portion of the will specifying these objects are:

1. To secure the honest and impartial enforcement of the terms of all contracts made by the City of Philadelphia providing for the furnishing by contractors of labor, or for the erection of buildings, the construction of public improvements, the cleaning of streets, the removal of refuse, including the proper method of carting ashes and garbage, etc., the furnishing of water, gas, electricity or transportation facilities or the performance of any other work, or the furnishing of any other supplies of any kind or nature for the said city.

2. To obtain the prompt prosecution of and just punishment of all persons guilty of violating contracts with said city or of peculation from its funds either directly or indirectly.

3. To investigate municipal affairs in the City of Philadelphia, and obtain and disseminate information in relation thereto, to aid the officers of departments of the city by advice as to the methods of municipal work, to frame proper legislation in regard thereto, and to aid in the inauguration or conduct of movements for municipal reform and generally for such purposes as will contribute toward the improvement of governmental conditions in the City of Philadelphia.

4. To assist in any special investigation in aid of any special public movement, in the investigation of any department of the city, to assist in the prosecution of any class of frauds or crimes, including frauds against the election laws, and in any other public service that they may deem proper.

5. To further the immediate adoption by the City of Philadelphia of a wise, clear and accurate system of bookkeeping and accounting, including as a feature thereof the frequent publication of lucid statements as to its financial condition.

6. But it is my will that the funds at the disposal of said board shall never be used to further the interests of any political party, or to secure the election of any officer of the municipal government, or for any similar purpose, it being my intention that this fund shall be used for the express purposes of this trust, and not as an instrument of partisan politics, for which reason I have endeavored to have the trustees selected by the most representative and public spirited corporate bodies of the City of Philadelphia

The seven trustees of the bequest are to be named one each by the Franklin Institute, the Law Association of Philadelphia, the College of Physicians, the City Club of Philadelphia, the Board of Trade, the Board of City Trusts, the University of Pennsylvania.

The latest estimates place the probable size of the trust fund at a half million dollars instead of a million dollars, as published in *Engineering News-Record* of June 5, 1919.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

The New Edition of Trautwine

TRAUTWINE'S CIVIL ENGINEER'S POCKET-BOOK—By John C. Trautwine, Civil Engineer; Revised by John C. Trautwine, Jr., and John C. Trautwine, 3d., Civil Engineers, 20th Edition. Philadelphia, Penn.: Trautwine Co. London: Chapman & Hall, Ltd. Montreal: Renouf Publishing Co. Flexible Cover; 4 x 7 in.; pp. 1528; illustrated. $6.

Practically the only change in the new edition of "Trautwine" is the expansion of the section on railways from 70 to 327 pages. This section of the book was referred for review to H. R. Safford, engineering assistant to the regional director, Central Western region, United States Railroad Administration, who expresses the following views:

The Expanded Railway Section

"In the section on track, the treatment of turnouts should be specially helpful to the younger engineer; its diagrams are unusually clear and complete, some of the more complicated diagrams being printed in black and red to represent practical and theoretical conditions, respectively. The use of the terms 'sweep' and 'sharpness' of curves in lieu of "central angle' and 'degree of curve,' respectively, is an innovation against which no special criticism can be offered, though it is unlikely that the new expressions will meet with general acceptance.

"The discussion relating to the use of chords less than 100 ft. in length is pertinent and shows clearly that this method should be adopted for very sharp curves. On the other hand, transitmen must not be made to feel that the use of the 100-ft. chord is not sufficiently accurate for the ordinary conditions of railroad work. The matter on resurveys of curves and the 10-chord spiral is a helpful addition to this section, which covers practically all phases of curve work but seems better adapted for reference purposes than for field use.

"Signaling is explained as to its fundamentals and the basic types of signals and signal systems. Yards and stations are discussed in comprehensive outline and the treatment of the elementary features of yard development seems to be complete. In view of the extended discussion of curves it would seem desirable that the section on earthwork, in addition to the quantitative tables given, should include a treatment of methods of staking and computing earthwork. The cost data will be helpful in estimating, being based on an arbitrary rate which may be converted to prevailing wage schedules.

"Rolling stock is treated in a nontechnical manner, with tables of weights and dimensions and data on locomotive performance, all of which is required by engineers engaged in the construction and maintenance of railways. The matter on train resistance is a summary of the better known and more important experiments, but omits the simple and very satisfactory general formula given in the 1915 'Manual' of the American Railway Engineering Association. In the section on train operation cost which is devoted to the economics of railway location, the application of the formulas is based on ratios taken from the Interstate Commerce Commission report of 1911, but while these ratios have been materially altered in the past few years, this does not detract from the value of the methods given. The treatment of construction-cost estimates is commendable because the locating or constructing engineer must now be well versed in cost analysis and methods of accounting as prescribed by the Interstate Commerce Commission. The cost data have been derived from appraisals prior to 1914 and must be adjusted for estimating under present conditions.

"The use of much material from the 'Manual' of the American Railway Engineering Association is commendable on account of the earnest work of that body in developing the science of railway maintenance and operation to a higher standard than has existed heretofore."

Need for Further Revision

Comment upon the new "Trautwine" in general is an appropriate supplement to the foregoing review of its railway section. That the addition of some 250 pages on railways and railway engineering should be practically the only change seems surprising in view of the great number and variety of subjects included in the "Civil Engineer's Pocket-Book," and in view also of the developments during the 10 years since the previous edition. In that edition (1909) there was a great enlargement of the section on concrete; this remains almost unchanged, although there have been important developments. Highways are now much more prominent than railways in engineering affairs, yet the book has practically nothing on this important subject. Information on dams is limited to brief explanation of the design of masonry dams and the construction of timber dams. There is nothing in regard to arched dams, earth dams, rock-fill dams or buttressed dams. The list of largest bridges is dated 1902.

Assuming that an enlargement of, say, 250 pages was considered practicable, it would appear that the value of the book could have been increased very greatly by apportioning this additional space among certain subjects which are of special importance or in which special progress has been made. As an illustration, over 100 pages are devoted to railway curves and 36 to cost of construction, but there is nothing as to highway curves or cost. Other examples might be cited, all indicating a lack of proportion, both in compilation and revision.

That a more general and diversified revision would have produced a better balanced and more valuable book seems indisputable. It is evident that such a book cannot go into detail on each and every subject, but it should cover adequately the various general branches of engineering work. This result cannot be attained by simply adding detailed treatment of individual subjects at long intervals.

Shore Processes and Shoreline Development

SHORE PROCESSES AND SHORELINE DEVELOPMENT—By Douglas Wilson Johnson, Associate Professor of Physiography, Columbia University. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 583; illustrated. $5.

Knowledge of the operation of natural forces has to be part of the equipment of every engineer. Particularly must this be so with those engineers who are building, maintaining or operating structures in or near great bodies of water. The movement of the shore—that is, the border between water and land—is the base of a science in itself. Engineers cannot be expected to study such a science in all of its details; that must be left to the geologist who is concerned with age-long phenomena, but the engineer can profit by the geologist's study, and skim the cream from his work.

Professor Johnson's book will have just this value for the engineer. It was written, so the author states, in order to set down fully all of the known facts on which could be based arguments as to the progressive subsidence of the Atlantic coast of North America within historic time. To do this it seemed necessary to inquire somewhat fully into the fundamental principles of shore processes and shoreline development. He has, therefore, set himself the task of bringing together the results of shoreline study, published in different languages, of analyzing and criticizing conclusions and of presenting a digest of those fundamental principles which should prove to be best established by the independent work of various students and supported by his own observations.

The result is a formidable volume to the engineer who is not accustomed to the methods of pure science. It is heavy with bibliography and reference to published work, but the impression is unavoidable that it is authoritative. Any engineer who is concerned with marine structures, with the protection of shore and coast line, with the maintenance of harbors, the construction of harbor structures, or the development of the mouths of rivers, will profit by a study of the book. It sets down in considerable detail all of the known facts regarding waves and currents and the phenomena of shore building and destruction. While the treatment is mainly a geological one, which means that geological eras rather than human eras are considered, still the engineer who deals only with the human era can learn with profit how the geological processes work.

Statically Indeterminate Problems

ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES by the Slope-Deflection Method—By W. M. Wilson, Assistant Professor of Civil Engineering, F. E. Richart, Instructor in Theoretical and Applied Mechanics, and Camillo Weiss, Instructor in Structural Engineering. University of Illinois, Urbana, Ill.: Engineering Experiment Station. Paper; 6 x 9 in.; pp. 218; illustrated.

Applying the fundamental relations of the slope-deflection method to many practical cases of rigid frames acted upon by various loadings, the authors of this bulletin have developed useful equations to aid in the solution of relatively difficult statically indeterminate problems. All solutions are based upon an assumption of constant moment of inertia, a fact which should have been stated more definitely in outlining the assumptions underlying the analysis.

The treatment includes: Girders with fixed ends; continuous girders, including a derivation of the theorem of three moments; two-legged rectangular bents, fixed and hinged; trapezoidal bents; frames consisting of a large number of rectangles under various symmetrical loadings; three-legged bents, fixed and hinged. The effect of settlement or rotation at supports is included in the analyses, and examples given indicate the relatively large moments introduced by such movements. In the conclusions, various advantages of the slope-deflection method are mentioned, and the belief is expressed that the principles brought out will throw new light on indeterminate problems.

American Air Service

THE AMERICAN AIR SERVICE: A Record of its Problems, its Difficulties, its Failures, and its Final Achievements (Problems of War and Reconstruction). By Arthur Sweetser, Sometime Captain, Air Service, U. S. A.; with an Introduction by Newton D. Baker, Secretary of War. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 384; illustrated. $2.50.

It may be too soon after the confusion of charges and countercharges surrounding our aviation program for anyone to read dispassionately the history of the United States' eighteen months of war flying. Actual figures a year ago were scarce. Rumors were plenty, and even today there are few who know whether the rumors or the announced figures of those days were correct. In this book Captain Sweetser sets down soberly the chronicle of the American air service in the war. It is an absorbing history, and one which all of the credulous parties of 1918 should read, if for no other reason than to set up in their own minds the difference between cold facts and current rumors.

Watertown Arsenal Tests

TESTS OF METALS AND OTHER MATERIALS: Report Made in the Ordnance Laboratory at Watertown Arsenal, Massachusetts, During the Fiscal Year Ended June 30, 1917—Washington, D. C.: Chief of Ordnance. Cloth; 6 x 9 in.; pp. 275; illustrated.

Some matters of exceptional interest are included in the recently issued report on Watertown arsenal work during the year ending with July, 1917. Impact testing of steel by the Charpy test formed a prominent feature of most of the tests and researches reported upon. The preface states that the resulting data form material for a general study of the significance of the Charpy test, but no separate report on the subject is included. Transverse tensile test pieces from forgings were studied in a number of cases, and the results indicated that this is a most important field of investigation. Triangulation of micro structure was observed in some nickle-steel specimens. The report abounds with excellent reproductions of micrographs.

An interesting portable polishing device for use on large and heavy specimens was developed at the arsenal; this is fully described and illustrated in the present volume. It consists of a small motor with grinding and lapping heads directly attached and a guide tube for holding the working head steady and giving a true surface.

Our Production of Munitions

AMERICA'S MUNITIONS, 1917-1918; Report of Benedict Crowell, Assistant Secretary of War, Director of Munitions—Washington, D. C.: War Department. Cloth; 6 x 9 in.; pp. 592; illustrated.

Assistant Secretary Crowell is to be complimented upon the complete record of the munitions efforts of the United States which is exhibited in this book. During the war we heard much that was rumor but very little that was fact. Now that the war is over the real facts can be made public. The magnitude of our war efforts can well be measured by the magnitude of our munitions production which this book describes in full detail. "Munitions" these days means many things. So

the book, in its separate chapters, takes up the various products of the War Department during the war. These include not only ordnance, which is by right included under the term, but also the air service, the engineer corps, chemical warfare, the quartermaster department, the construction division, and the signal corps. What American industry, mobilized for war service, could really do in eighteen months was marvelous. Every true American ought to read the record and be proud.

New Searles and Ives' Handbook

FIELD ENGINEERING: A Handbook of the Theory and Practice of Railway Surveying, Location and Construction—By William H. Searles, M. Am. Soc. C. E. 18th edition, revised and enlarged by William H. Searles and Howard Chapin Ives, Professor of Railroad Engineering in the Worcester Polytechnic Institute. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Flexible Leather; 4 x 7 in.; Vol. I, text; pp. xviii + 309; 4 illustrations. Vol. II, tables; pp. vi + 326. Bound in one volume, $3 net; bound separately, $2, net, each.

This latest addition of Searles' well-known handbook on railroad curves differs from the previous edition (which was reviewed in *Engineering News*, Jan. 20, 1916, p. 116) by the addition of the American Railway Engineering Association spiral, together with the new tables necessary to simplify the application of the same. The method of treatment in the discussion of this spiral is somewhat original. The total issue of the handbook is 59,000 with this edition.

Peddle's "Graphical Charts" Revised

THE CONSTRUCTION OF GRAPHICAL CHARTS—By John B. Peddle, Professor of Machine Design, Rose Polytechnic Institute. Second Edition. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 158; illustrated. $2.

In bringing out a second edition of his work on graphical charts, Professor Peddle has added an interesting chapter giving an ingenious and very resourceful method for constructing alignment diagrams. While determinants are used in carrying out this method, no great mathematical difficulty is involved, and it should be suitable for very wide use. With this exception the book is substantially unchanged. As in the first edition, therefore, main emphasis is laid on alignment diagrams, which the author appears to favor because of their wide range of utility. The first edition of this work was reviewed in *Engineering News* of Nov. 17, 1910, p. 46.

French and American Government

HOW FRANCE IS GOVERNED—By Raymond Poincaré of the French Academy and President of the Republic; Translated by Bernard Miall. New York: Robert M. McBride & Co. Cloth; 5 x 8 in.; pp. 336. $2.

THE GOVERNMENT OF THE UNITED STATES, NATIONAL, State and Local—By William Bennett Munro, Ph. D., LL.B., Professor of Municipal Government in Harvard University. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 648. $2.75.

With light but firm touch President Poincaré sketches the government of France, both in its development and as now constituted. Some attention is given to the commune and the department but most of the space is devoted to the national Government.

In his much larger volume on the United States Professor Munro covers Federal, state, county and municipal government, from Colonial times to the present day. Constitutional principles, limitations and interpretations are given careful attention. Comparisons of American and European systems are made. The need for improvement in state administration is urged. Stress is laid on the advantages of the commission plan of city government and particularly of the commission-manager plan, but here, as elsewhere throughout the book, disadvantages are also presented. The volume is a worthy addition to Professor Munro's series of books on government.

Walls, Bins and Grain Elevators

THE DESIGN OF WALLS, BINS AND GRAIN ELEVATORS—By Milo S. Ketchum, C. E., Dean of the College of Engineering and Professor of Civil Engineering, University of Colorado; Consulting Engineer; M. Am. Soc. C. E., etc. Third Edition. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 556; illustrated. $4.

To this standard work there has been added enough material to bring it up to date. This consists mainly in the abstract of the report on the design of retaining walls by the American Railway Engineering Association, which, as the author truly says, "for the first time has defined a standard practice for the design of retaining walls and abutments." With the added matter, the book is more than ever a necessary part of the engineer's working library.

Machine-Made Pipe

MACHINE-MADE CEMENT PIPE FOR IRRIGATION SYSTEMS AND OTHER PURPOSES—By G. E. P. Smith, Agricultural Experiment Station, The University of Arizona. Tucson, Ariz.: The Station. Paper; 6 x 9 in.; pp. 171; illustrated.

Professor Smith has had a large experience in the arid West with the use of concrete pipe. This bulletin is an abstract of this experience and contains probably more authoritative, unbiased information on this subject than any other similar publication. It not only describes in some detail the various machines for the manufacture of concrete pipe, but elaborates from known failures methods by which better pipe may be obtained.

"Building for Victory"

A spirited article entitled "Building for Victory," by Col. William A. Starrett, has been reprinted from *Scribner's Magazine* for November, 1918, by the Thompson-Starrett Co., New York City. At the time the article was written Colonel Starrett was head of the Emergency Construction Section, War Industries Board. The article is devoted largely to the $50,000,000 powder plant built at Nitro, W. Va., by the company already mentioned, but the article does not give the name of the contractor.

Books on War Work

Two very elaborate and handsome books describing the war activities of special organizations have just been published. One of these is entitled "A Record of War Activities" and published by the Turner Construction Co., of New York. The other, entitled "Shell Loading at Amatol, N. J.," is published by the Atlantic Loading Co., of New York City. Both are handsome examples of the bookmaker's art and both represent the commendable desire on the part of their publishers to make a permanent record of the effective aid they rendered to the Government during the war.

The Turner company's book recites in detail, with appropriate line and halftone illustrations, the numerous buildings, mostly of reinforced concrete, that the company erected during the war. At the head of these is, of course, the United States Army Base in Brooklyn, N. Y., one of the largest individual contracts of the war, but there are a number of other buildings, including the Navy Base at Brooklyn, the Coast Artillery Barracks at New York, the buildings for the Bureau

of Standards at Washington, concrete office buildings at Washington, and a number of varied jobs for the United States Navy.

The Atlantic Loading Co.'s book is a description, prepared by Victor F. Hammel, M. Am. Soc. C.E., of the shell-loading plant and town called Amatol, built especially for the Ordnance Department on a sandy waste about half way between Philadelphia and Atlantic City. Here on a tract of 6,000 acres was put up an enormous plant in which ammunition for the Western front was loaded.

Bridge and Culvert Surveys on Iowa Roads

For securing uniform and complete information in investigating sites for bridges and culverts, detailed instructions have been prepared by the Iowa Highway Commission, issued to the field engineers in the form of a 24-page pamphlet 4½ x 7 in. The instructions are not simply brief and more or less imperative rules, but are in a readable and explanatory style and give particular attention to the reasons why certain things should be done or observed. After the location of the structure by its position, local name, road and stream, the present structure is to be described as to its type, dimensions, condition and waterway efficiency. The location of the new structure is then to be described and considerable space is given to outlining the information which should be shown on the plans. Finally, there are notes as to the engineer's recommendations for the new design, including its type, span arrangement, width, elevation, foundations and special or future loading requirements.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

BOILER CHEMISTRY AND FEED WATER SUPPLIES—By J. H. Paul, B.Sc., F.I.C., Consulting and Analytical Chemist New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 242; illustrated. $4.50.

CAMBRIA STEEL: A Handbook of Information Relating to Structural Steel—Prepared and Compiled by George E. Thackray, C. E., Special Engineer, Cambria Steel Co. 12th Edition. Philadelphia, Penn.: Cambria Steel Co. Flexible Cover; 4 x 7 in.; pp. 603; illustrated. $1.50.

Enlarged by about one-fifth as compared with the 11th edition (1917), the revised Cambria contains many new tables. New steel sections are shown, including bulb angles, channels, T-bars and various miscellaneous sections. The beam connection angles of previous editions have been modified "in view of well recognized practice."

CHEMICAL AND BIOLOGICAL SURVEY OF THE WATERS of Illinois: Report for 1917. Urbana, Ill.: Department of Registration and Education. Paper; 6 x 9 in.; pp. 133; illustrated.

CITY PLAN FOR AKRON: Prepared for Chamber of Commerce by John Nolen, City Planner. Akron, Ohio: City Improvement Committee. Paper; 8 x 11 in.; pp. 91; illustrated.

The latest of six planning studies by the author for the improvement of Akron. After a general review of the existing plan and its various elements, this report takes up main thoroughfares, the downtown district, parks and zoning. The law relating to city planning for Akron is reviewed by Frank B. Williams, of the New York Bar.

CONCRETE-STEEL CONSTRUCTION, PART 1—BUILDINGS: A Treatise Upon the Elementary Principles of Design and Execution of Reinforced-Concrete Work in Buildings—By Henry T. Eddy, C.E., Ph.D., Sc.D., LL.D., and C. A. P. Turner, C.E. Second edition, rewritten and embodying the most advanced theoretical developments. Minneapolis, Minn.: The Authors. Cloth: 6 x 9 in.; pp. 502; illustrated. $10.00.

CONNECTICUT HIGHWAY COMMISSION: Annual Report of the Highway Commissioner to the Governor, Oct. 1, 1917-18. Hartford, Conn.: The Commission. Paper; 6 x 9 in.; pp. 89; folding tables.

ELASTIC STRESSES IN STRUCTURES: Translated from Castigliano's "Theorem de L'Equibre des Systemes Elastiques et Ses Applications"—By Ewart S. Andrews, B.Sc., Eng. (Lond.), Consulting Engineer, etc. London: Scott, Greenwood & Son. New York: D. Van Nostrand Co. Cloth; 7 x 10 in.; pp. 360; folding plates. $9.00.

EXCAVATION, MACHINERY METHODS AND COSTS—Including a Revision of "Excavating Machinery"—By Allen Boyer McDaniel, S.B., M. Am. Soc. C. E.; Principal Engineer, Construction Division of the Army. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 542; illustrated. $5.

FARM WATER SUPPLY—By F. H. Peters, Commissioner and Chief Engineer of Irrigation, Department of the Interior. Calgary, Can.: The Commissioner. Paper; 6 x 9 in.; pp. 27; illustrated.

Designed for distribution to farms in the semi-arid districts of Alberta and Saskatchewan Provinces. Deals principally with volume of water required for house and stock use; earth reservoirs; rain catchers (for roof water); and methods of treating water.

FORESTS OF BRITISH COLUMBIA—By H. N. Whitford, Ph.D. and Roland D. Craig, F.E., Under the Direction of Clyde Leavitt, Chief Forester, Commission of Conservation. Ottawa, Can.: The Commission. Paper; 7 x 10 in.; pp. 409; illustrated.

AN INDUSTRIAL HOUSING DEVELOPMENT at Union Park Gardens, Wilmington, Del., for the United States Shipping Board, Emergency Fleet Corporation. Philadelphia, Penn.: Ballinger and Perrot. Paper; 7 x 10 in.; pp. 23; illustrated.

INDUSTRIAL TRAINING IN REPRESENTATIVE INDUSTRIES: A Survey of Practical Value to the Man Who Wants to Know How Training Departments Operate. Washington, D. C.: U. S. Department of Labor. Paper; 6 x 9 in.; pp. 15.

KENTUCKY ROAD LAWS, 1918: Compilation of Road Laws Other Than Those in Carroll's Statues, 1909. Frankfort, Ky.: Department of Public Roads. Paper; 6 x 9 in.; pp. 127.

THE LAW OF GOVERNMENT CONTRACTS—By R. Preston Shealey, LL.M., of the Bar of the Supreme Court of the United States, and of the District of Columbia. New York: Ronald Press Co. Cloth; 6 x 9 in.; pp. 300. $4.

METHOD OF ADMINISTERING LEASES OF IRON-ORE DEPOSITS BELONGING TO THE STATE OF MINNESOTA—By J. R. Finlay. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 40. 5c. from Superintendent of Documents.

NEW MEXICO LAWS ON HIGHWAYS AND BRIDGES—Santa Fe, N. Mex.: State Highway Commission. Paper; 6 x 9 in.; pp. 67. $1.25.

NEW YORK PUBLIC SERVICE COMMISSION: Report, 1918—Albany, N. Y.: The Commission. Cloth; 6 x 9 in.; pp. 652.

OPPORTUNITIES IN CHEMISTRY—By Ellwood Hendrick [Opportunity Books]. New York and London: Harper & Brothers. Cloth; 5 x 7 in.; pp. 101. 75c. net.

Information, entertainment and suggestion are offered by this familiar "talk" on the opportunities of chemistry as a profession. The volume is well worth reading by those who wish to know something of what chemistry embraces, even though they may have no idea of practicing it.

POWER WAGON REFERENCE BOOK, 1919: A Handbook of Practical Information for Makers, Sellers and Owners of Motor-Driven Vehicles for Commercial and Agricultural Purposes—Edited by Stanley A. Phillips, Editor of the *Power Wagon*, Chicago, Ill.: The Power Wagon Publishing Co. Cloth; 9 x 12 in.; pp. 368; illustrated. $2.50.

REPORT UPON THE CONSTRUCTION AND MAINTENANCE OF MILITARY AND POST ROADS, BRIDGES AND TRAILS, ALASKA; Board of Road Commissioners for Alaska in Charge. Extract from Annual Report of the Chief of Engineers, 1918 (Washington, D. C.). Paper; 6 x 9 in.; pp. 24; illustrated.

THE SPACING AND DEPTH OF LATERALS IN IOWA UNDERDRAINAGE SYSTEMS AND THE RATE OF RUN-OFF FROM THEM WITH DATA FROM INVESTIGATIONS—By W. J. Schlick, Drainage Engineer, Engineering Experiment Station, Iowa State College of Agriculture and Mechanic Arts. Ames, Iowa: The Station. Paper; 6 x 9 in.; pp. 119. Illustrated.

STABILIZING THE DOLLAR IN PURCHASING POWER—By Irving Fisher, Professor of Economics, Yale University, etc. Reprinted from "American Problems of Reconstruction." Address the Author, New Haven, Conn. Paper; 5 x 7 in.; pp. 30.

STATISTICAL ABSTRACT OF THE UNITED STATES, 1918—Washington, D. C.: Bureau of Foreign and Domestic Commerce. Cloth; 6 x 9 in.; pp. 881. 50c. from Superintendent of Documents.

STATISTICS OF GOVERNMENT RAILWAYS: Report for 1916 to the Minister of Communications. Peking, China: The Minister, Department of Railways. Paper; 10 x 13 in.; pp. 48; illustrated.

STRUCTURAL WATERPROOFING: A Waterproofing Handbook and Reference Guide for the Use of Architects, Engineers, Building Contractors and Others Interested in the General Subjects of Waterproofing and Dampproofing. Detroit, Mich.: The Truscon Laboratories. Paper; 8 x 11 in.; pp. 87; illustrated.

Although containing a special plea for the use of the waterproofing compounds manufactured by the Truscon Co., this booklet has as preliminary chapters some very good analyses of the theory of waterproofing and the applications of the various methods employed.

THE THEORY OF UNDERDRAINAGE—By W. J. Schlick, Drainage Engineer, Engineering Experiment Station, Iowa State College of Agriculture. Ames, Iowa: The Station. Paper; 6 x 9 in.; pp. 57; illustrated.

Physical, agricultural, engineering and financial aspects discussed by the drainage engineer of the institution named.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Corps of Engineers Not Behind Auxiliary Engineer Corps

Sir—Your issue of June 19, 1919, p. 1232, contains a letter from M. O. Leighton, chairman of the Engineers, Architects and Constructors' Conference on National Public Works, with the heading "The Reply of the Corps of Engineers, United States Army," in which it is affirmed that the Corps of Engineers is engaged in a campaign to militarize the public works functions of the Federal Government, and is advocating the passage of a bill designated "S. 1376, Sixty-sixth Congress, First Session," providing for an "Auxiliary Engineer Corps."

In order that members of the engineering profession, who are not in a position to keep in touch with the progress of current legislation, may not be under any misapprehension on the subject, I take pleasure in informing you that the Corps of Engineers has not interested itself in any manner whatever in the bill in question.

It is supposed that the bill was drawn by one of the clerks in a field office, who has been interesting himself in the subject in question, and that the measure was introduced at his request. When the matter came to the attention of the Chief of Engineers, the view was taken that the activities of the employee in question were probably within his privileges as a citizen, were undoubtedly prompted by patriotic motives (however impractical the scheme proposed), and were consequently not an appropriate basis for official action looking toward their suppression.

It may be remarked that the *Army and Navy Journal*, in its issue of June 28, 1919, printed a statement that the Chief of Engineers is in no way responsible for the bill, and that he believes the proposed legislation impracticable, and that it would be detrimental to the public interest. The most casual inquiry at the Office of the Chief of Engineers would have elicited similar information.

You will, I am sure, give this letter the publicity that is merited by such a wholly unwarranted, if somewhat absurd, attack on the probity of the Corps of Engineers.

W. M. BLACK,
Major General, Chief of Engineers.

Washington, D. C.

Stop College Supply of Graduate Engineers

Sir—The American Association of Engineers, the Engineering Council, and the Draftsmen's Union, are attempting to plug the dyke with their fingers whilst the great deluge of engineers strive to break in. Colleges know nothing of the law of supply and demand, and care less—their interests are in endowments and legislative grants.

Now comes a course in highway transport engineering. Who is going to employ the coming flock of H. T. E.'s? The United States is full of engineers working at everything else but engineering. Who wants a highway transport engineer, anyhow? No advertisements have yet appeared in the *Engineering News-Record* for such a man. There is no question that the subject of motor-truck terminals is acute in the large cities, but we do not need a new flood of engineers to show us the way out. The course for a highway transport engineer reminds me of the prospectus of our old friend Tom—of Yukon gold fame.

The engineering profession needs a closed season for a few years to adjust itself, otherwise a boy will come out of college with a degree in civil engineering and be met at the gate by a delegate of the union; and the chances are that he will not be out in the cold world very long with his little oyster fork before a union will look good to him.

F. N. HARRIS.

Olympia, Wash.

Commends Development Committee Report

Sir—The highly commendable and progressive report of the Committee on Development of the American Society of Civil Engineers very forcibly illustrates the benefits that may be derived from a truly representative body. In this report is promise of real reform. The 22 delegates who came to the deliberations from direct intimate contact with the 22 local associations felt the need of reform and could speak with authority as to the wishes of their constituents. I am convinced that the governing body of the society should be composed of direct responsible representatives from local units. Why not make the "annual conference of representatives from local associations," which the report suggests, the governing body? This suggestion, combined with the one "that every member of the society be a member of a local association," will solve the present unresponsive conditions that hamper the society's management.

We may well take great pride in the society's past achievements and its present high standing, but reform and progress must be the program of the immediate future if deterioration and decay are not to destroy the very things in which we take much pride.

The committee has made a splendid beginning but it is only a beginning. The next move will be working out and putting into operation the suggested reforms. If the rank and file of the membership continues the attitude of listless indifference that has been so prevalent in the past, all these much desired improvements will die aborning. The 22 local associations, having a total membership of less than 25% of the membership, have the movement well under way. If, however, the unattached members do not rally to its support there will be no ultimate reform.

I am convinced that the vast majority of the membership desires reform (not revolution), but instead of assisting they merely criticize or are coldly indifferent.

This will as surely defeat the hopes of progress as active resistance. The ultraconservative elements are able to, and do, take full advantage of this passivity. The time seems ripe for an immediate forward movement and the nonactive membership alone will be responsible if it does not occur.

The ultimate goal that should be kept in view is broad engineering unity, and the greatest steps toward it will

be by reform in the older national societies and the unstinted support of the entire profession to Engineering Council in its high-minded, far-reaching efforts to serve.

W. H. WOODBURY,
Duluth, Minn. M. Am. Soc. C. E.

British and American Building Prices

Sir—It may be of interest to many of your readers to read a comparison of prices of American building materials with the prices of those sold in England.

In the *Daily Mail* overseas edition, builders' supplement, are prices of various building materials. The majority of the items are quoted delivered London, and, for comparison, the long ton and pound sterling have been converted into short ton and dollars.

A few of the items are quoted below:

	Delivered London	Delivered Boston
Cement	$2.72 bbl.	$2.37 bbl.
Reinforcing steel	89.50 ton	60.00 ton
Spruce lumber	70.00 thousand	45.00 thousand
Lime	11.32 ton	25.00 ton
Brick	11.43 thousand	18.00 thousand

It will be noticed that brick and lime are the items of material quoted above which are cheaper in England. The brick sold in England is a larger-size brick than the one sold in America.

Of course, the majority of the buildings and dwellings are constructed of brick in England and the brick industry is therefore very large. Clay and chalk are plentiful, hence the reason for cheapness of lime. In this country lime has gone up considerably during the last few months.

ALBERT G. DUKE,
Estimating Department, Aberthaw Construction Company.
Boston, Mass.

Function of Corporate Contract Bonds

Sir—All contractors and engineers should be greatly indebted to H. W. Swart for his interesting and illuminating article published in the *Engineering News-Record* of June 19, 1919, p. 1212, on the "Function of Corporate Contract Bonds—How Obtained," as the subject is one which is not fully understood by many, and articles such as Mr. Swart's will be read with profit by most engineers and contractors.

In general, contractors of experience well understand the intimate and confidential relationship that should exist between them and their bonding companies, that the business cannot be conducted on any other basis, and very freely impart the information needed by the bonding companies to consider properly their applications; but frequently some contractor gets a contract which perhaps is very much larger than any he has previously handled and is much surprised to find that the bonding company desires to make a full investigation of his financial standing, the adequacy of the prices bid, etc., before writing his bond. He perhaps resents it a little and does not realize that when the bonding company goes on his bond they are really extending him credit to the amount of the bond, and getting their suretyship is very much like getting a loan from a bank.

He might get $10,000 loans from his bank very easily, but the bank's investigation would be much more thorough if he tried to obtain a $75,000 loan, and very frequently the bank can afford to take more of a chance on the contractor than can the bonding company, because the bank is in a position to keep constantly informed of his financial prospects and can reduce its credit, obtain assignments of payments or get off altogether, if it finds the contractor is not progressing favorably. The bonding company, however, once on, has to stay on until the job is completed, all bills paid and official acceptance made.

Engineers, reputable contractors and bonding companies are all interested in the elimination of the irresponsible bidder, and one of the surest and quickest ways of doing this is for the first two to encourage the bonding companies to make full investigations of all bond applications. The good contractors can stand it, while the other kind cannot. The engineers could help present conditions by allowing more time between the awarding of the contract and the filing of the bond, because the interval usually permitted is quite short for a full investigation, or arranging for the reinsurance which is generally considered desirable on most of the larger risks. They also can assist by seeing that the contractor is supplied, for the bonding company, with a copy of the contract properly filled out, with options accepted as it will be executed, a set of the drawings and a tabulation of all the bids.

Bonding contractors is not like writing insurance for them, and the data submitted must prove the contractor is worthy of the confidence and suretyship of the bonding company, and engineers are frequently called on to tell what they know of the ability and experience as well as the honesty of contractors who have done work for them. In investigating the adequacy of the prices bid, it is always desirable to know the prices bid by the other bidders; but sometimes the surety company is told that the engineer or owner considers these data as private and will not impart them. The writer believes it is for the best interests of the owners and their engineers, if they will coöperate with the surety companies for full investigations before bonds are written, and also will supply information when called on for this purpose.

EDWARD W. BUSH,
Home Office Engineer, Ætna Casualty & Surety Co.
Hartford, Conn.

Consulting Engineers in France

Sir—A few years ago I read in the *Engineering News* or the *Engineering Record*, I forget which, an editorial on consulting engineers in Europe. From the editorial I gained the impression that the engineer in private practice is comparatively unknown in continental Europe, and seemed to be confined to the British Empire and the two Americas. The facts above stated were obtained as one result of an investigation made by the American Society of Consulting Engineers.

After a residence in France of two years I am forced to the conclusion that someone made an error. In France the engineer in private practice is not by any means unknown. I am informed that he is numerous throughout all Europe. This statement is made as a result of numerous inquiries on my part. Since the armistice went into effect my opportunities for judging have been improved, as I am now engaged in the settlement of damage claims.

In practically every place of any importance there are architects and geometers. Sometimes the geometer is also an architect. Generally the architect is also a geometer. A geometer is our old friend the surveyor. He not only makes surveys but he estimates costs of

building work, repairs and dilapidations. He prepares an *Etat de Lieux* before a lease is signed and an *Etat de Proprieté* before final payments are made on the termination of the lease. He values damages to crops, etc. In short, he does all kinds of work in which a knowledge of mathematics is required, and occasionally he is referred to as an expert mathematician.

The work "expert" over here is in common use, and not used half derisively as in the United States. By the way, it is sometimes difficult for an American to keep a straight face when a new-found friend calmly announces himself as an "intellectual." An intellectual seems to be a university graduate who does not labor with his hands and who occasionally contributes articles to magazines and is called upon more or less frequently to make public addresses.

I find the "geometers" in France enjoy (?) about the same general prosperity as men in similar work in the United States. They seem also to be about as contented (?) with their choice of a profession.

In the larger cities, especially in Paris, there are not only numerous architects but there are men who practice engineering. *L'ingenieur conseil* is by no means unknown. The greater part of his work is not on important enterprises but from observations made by me he is not different from his American colleagues. Not all enterprises are conducted by the Government and private initiative is allowed considerable scope. There exists therefore a field for the engineer in private practice. This field is as well occupied as it is in America. That is, if there were fewer men engaged in private practice as engineers the general lot would be improved.

The engineer, however, is an intellectual; that is, a highly educated man, and as such his social condition is good. He may, in common with all intellectuals, including army officers, maintain his social position by espousing the daughter of a well-to-do man who is not an intellectual. If he does this he is relieved of considerable mental distress as his living is assured and he can pick his work and specialize in high-grade clients. He may even branch out into contracting work.

Tours, France. ERNEST MCCULLOUGH,
Lieutenant Colonel, R. R. & C. Service, A. E. F.

Federal Employees' Union and Strike Methods

Sir—Relative to the Draftsmen's Union and your editorial in that connection in the issue of June 12, 1919, and the question as to the methods to be used in enforcing collective bargaining and recognition of the union and its demands, I would call your attention to the fact that the Federal employees of the United States are now unionizing, and local unions are being rapidly formed not only in Washington but all over the country.

The objects and methods of the Federal Employees' Union is set forth in their constitution, and shows how they hope to secure recognition and results by other than the so-called "union methods," as follows:

"In order to promote the welfare of the members of the Federal service, to make the Federal service a more useful agency in good government, and to secure, through combined effort, the protection and security demanded by modern economic conditions, . . . we adopt this constitution.

"The methods of attaining these objects shall be petition to Congress, by creating and fostering public sentiment favorable to proposed reforms, by coöperation with Government officials and employees, by suggestions to the Civil Service Commission for the improvement of the service, and by legislation and other lawful means; provided, that under no circumstances shall this union engage in or support strikes against the United States Government."

It is believed, the results already secured would indicate that the belief is well founded, that results will be secured without resorting to the strike and other of the so-called "union methods" of the labor organizations. H. F. ROBINSON.

Albuquerque, N. M.

Actual Case Shows Something Wrong With Engineers' Remuneration

Sir—I was extremely pleased to see in your issue of June 19 several letters which you have received in reply to the letter of Mr. Ricketts.

It appears to me from Mr. Ricketts' letter that he is quite ignorant of the present salaries paid to engineers, even those holding positions of considerable responsibility and requiring high-class technical education. As a matter of fact; even Lucien Alter is under a misapprehension when he thinks that the average engineer, three years after graduation, would receive a salary of $2000 a year. The writer can evidence scores of cases where engineers, corporate members of technical societies, having many years of experience and holding positions of responsibility, are receiving salaries below the $2000 mark.

Mr. Ricketts is afraid that the letters published in *Engineering News-Record*, complaining about the remunerative value of engineering, might have a serious effect upon young readers who were thinking of becoming engineers. I believe if these letters do nothing else than prevent some young men from taking up engineering, by informing them of the true conditions that exist in the profession, they are quite justified. In my opinion, it is not only the duty of the press but even the duty of our universities, in justice to themselves, to the profession and to the prospective students, to carry on a campaign of information among high-school gradutes informing them of what they have to expect if they take engineering as their vocation. Let them know that on average engineering salaries they will not be in a position to support a family unless they have other income, that they will not be able to live up to the same standard as members of the ordinary trades unions and that they will be the beggars in the community.

Only recently an actual case was brought to my attention which amply proves my statement. The individual concerned is well known to me, and the facts that I wish to relate may serve to open the eyes of Mr. Ricketts to appreciate fully that the statement that "services receive the payment they are worth" may be true of every other trade or profession, but it certainly is not true in engineering. The facts are as follows:

About fifteen years ago two young men, "A" and "M," learned the same trade, garment making. Their earnings at that time were about $9 to $12 per week, the working hours being long, about 56 hours per week.

"M" was indifferent and apparently satisfied, but "A" was ambitious and desired to improve his position. Just at that time his attention was drawn to several articles which appeared in a magazine describing the great achievements of engineers. "A" always had a "hankering" after the engineering profession, which seemed to him to be the real backbone of industrial development, and decided to take up engineering as his vocation. His announcement was met with considerable discouragement from his friends and associates. The task seemed almost impossible, as "A" had no parents nor relatives who could help him. However, he worked in the factory during the day and studied at night for his matriculation. He saved up a little money and finally was successful in entering college. In order to cover his expenses he had to rise at 3 a.m. to peel potatoes in the boarding house for his board. In spite of his struggles, his class work was well done and during his last year at college, in addition to his purely technical work he chose for his electives such subjects as political economy, sociology and commercial law. With borrowed money he succeeded in completing his course and received his diploma in civil engineering.

He went into actual practice, worked hard, continued his studies, followed up current technical literature and at present, after 7 to 8 years' practical experience holds a responsible position as structural designer, handling the design of movable and fixed bridges and industrial buildings, at the magnificent salary of less than $170 per month.

While "A" was preparing for college "M" also saved up a little money and started work for himself, investing the money in cloth. Today he is a garment manufacturer rated at over $40,000.

Furthermore, what perhaps is of greater interest to Mr. Ricketts is that garment workers have only recently secured an agreement in which the minimum wage is fixed at $50 per week, with men of average ability receiving more. The working hours have now been reduced to 44 hours per week with time and a half for overtime.

Is it any wonder that "A" is dissatisfied with engineering, when after the struggles he has gone through and after being successful so far as technical attainments are concerned, he finds that he is unable to attain to the same standard of living as the men who are now following the trade which he had thrown over fifteen years ago to become an engineer?

Surely there is something wrong with engineering remuneration.

W. S. HARVEY,
Associate Member, Engineering Institute of Canada, and Institution of Civil Engineers.
Toronto, Canada.

Government Specifications Should Not Misplace Responsibility

Sir—There has appeared recently in your publication an interesting exchange of ideas, regarding the just and equitable form of Government contract. Most of your contributors appear to have been in favor of a cost-plus-fixed-fee contract, similar to those in vogue during the war. Apparently those in power at Washington have either not read these discussions or have quite contrary views on the matter, as can be readily seen by quoting a few articles from a recent Government specification:

Article 20, Method of Procedure:

The Government reserves the right to require the method of procedure to be such that the construction of the foundations of the crane runways will take precedence over other work, to the end that these foundations may be completed in time to avoid delay to the erection of the crane runways. The contractor will be required to leave the underwater portion of his work unwatered, until the steel work for the crane runway is completed, *if in the opinion of the officer in charge such procedure will expedite its completion.*

Article 24, Buried Constructions:

Such information as the Government possesses regarding sewers, pipes, and other construction beneath the surface of the ground on the site of the work may be obtained from the public works officers of the navy yard.....*The Government does not guarantee the information given to be correct,* or that other buried constructions will not be encountered, *and does not assume any risk or responsibility in connection therewith.* Intending bidders will have the privilege of examining the site, and they should satisfy themselves as to the existing conditions. In the event of interference developing between new construction and any obstructions on the site, the contractor shall be required to make all provisions necessary for the removal of such interference, as directed by the officer in charge, *without increased compensation.* In event of interference between new constructions and existing service lines, sewers, etc., to be maintained in place, it shall be incumbent upon the contractor to make provisions necessary for maintaining such services *as directed by the officer in charge.* Any valuable material salvaged shall be removed and stored as directed by the officer in charge.

Article 26, Pile Data:

The length of piles required in the construction of the .....*will be determined by the contractor.* Lengths of piles used in the construction of.....adjacent to the site are given on the drawings, and complete pile-driving data on these piles may be obtained from the officer in charge, but *the Government does not guarantee the accuracy of any of the aforesaid data,* and the contractor *must assume full responsibility for use of same* in connection with the new structure.

Article 37, Work to be Accomplished in the Dry:

The bidder's attention is invited to the requirement that all work on this project be placed in the dry, hence the use of cofferdams or other approved methods of unwatering the site will be required. The contractor shall submit to the officer in charge drawings, showing details of the cofferdam or cofferdams proposed to be constructed, *but any approval given thereon by the officer in charge shall not operate to relieve the contractor from full responsibility for the sufficiency of such constructions.*

Very little comment is required regarding the above quotations. These specifications apparently give the officer in charge about as much power and authority as the late lamented czar of Russia, leaving the successful contractor with very little beside his skin. It would seem as though all responsibility were thrown on the contractor, and that the Government was not willing to pay for what it might be getting.

Paragraphs such as these quoted are absurd and beyond all reason, and no self-respecting engineer would wish to be vested with the unbridled authority such specifications would give him. Is it not about time that a reasonable set of specifications be adopted by the Government?

E. D. BUEL.
New York, N. Y.

[Unfortunately this practice of writing specifications which relieve the engineer of responsibility for even his own work is not confined to the Federal Government, but is all too common in state, county and municipal work.—EDITOR.]

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Lost Time Reduced by Shifting Crews

By ALBERT S. FRY
Morgan Engineering Co., Memphis, Tenn.

LOST time from shutdowns of equipment is reduced by a definite plan for shifting crews in the dredging operations on the Inter-River Drainage District in Missouri. These crews, being paid by the month, receive full pay during any minor shutdown.

On the work named, if highwater shuts down one machine, or if a part breaks which cannot be replaced for some days, the monthly men are transferred to that other part of the work where they can be most useful. Each crew on each machine has one shift off a week. If for any reason a machine is not running, it is an easy matter to put its crew on the first machine whose crew is taking time off, and thus accomplish work which otherwise would not be done. If this is not practicable, the men may be put in the repair shop, where there is always something for them to do. Keeping the men busy also has a tendency to reduce breakdowns, because the men know that they will have to work somewhere and will not be allowed, if there is a breakdown, to loaf and draw their pay. J. W. Radford is construction superintendent on this work.

Other Articles in This Issue of Interest to Contractors

Dam Foundation Placed by Suspended Pneumatic Caissons — Page 108
Sewer-Construction Records Used at Scarsdale, New York — Page 111
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Function of Corporate Contract Bonds (Letter) — Page 142
Government Specifications Should Not Misplace Responsibility (Letter) — Page 144

Blasting Tests Show TNT Stronger Than Forty Per Cent Dynamite

TWO concrete piers that had to be blasted out by mudcapping recently gave an opportunity to compare TNT (trinitrotoluene) directly with 40% dynamite. C. E. Munroe and S. P. Howell of the Bureau of Mines, reporting on the results, say that these piers were 10 ft. long, 3½ ft. thick at the bottom, and 1½ ft. thick at the top, and 7 ft. high. They were broken up by dobey shots, using moistened clay for capping. When TNT was used, six shots, totaling 10.7 pounds of the explosive, removed 159.5 cu.ft. of concrete, or 14.9 cu.ft. per pound of TNT. With the dynamite, five shots, totaling 9.6 pounds, removed 135 cu.ft. of concrete, or 14.1 cu.ft. per pound.

Tests of the power of various explosives when fired in cavities in lead blocks, according to the standard method of the Bureau of Mines, gave the following results: Taking 40% dynamite as standard of power, or 100%, the series of explosives arranged according to increasing strength is as follows: Black powder, 10.5%; 40% gelatine dynamite, 73%; 40% straight dynamite, 100%; 50% straight dynamite, 105.2%; granulated TNT, 113.1%; 60% straight dynamite, 120.2%; blasting gelatine, 149.8 per cent.

Large quantities of TNT have been taken over by the Department of the Interior for industrial use. The material is a granular powder of yellowish or brownish color, different grades ranging from a fineness of 12 mesh to a fineness of 30 mesh. It is packed in wooden boxes containing 100 pounds. A No. 8 detonator must be used with this powder, where dynamite can be exploded by a No. 6. TNT is less sensitive to friction and less sensitive to percussion than gelatin dynamite, ammonia dynamite, picric acid, and 40% dynamite. The powder is quite poisonous. Further, 47% of the products of combustion is carbon monoxide, a poisonous gas, which makes it necessary to give time for the clearing away of the gases before approaching the face after a shot.

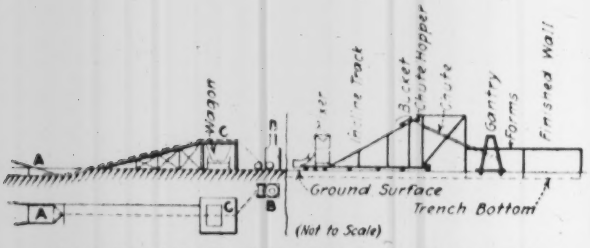
Except for the use of a heavier detonator, the handling of TNT is similar to that of dynamite. Munroe and Howell say: "TNT should be charged into bore holes, primed, tamped, and stemmed in the manner costomarily followed in the use of high explosives in blasting, special care being taken in charging wet holes not to tear or break the cartridge case or wrapper while loading it into the hole and tamping it. It may be used in chambering holes for subsequent charging with black blasting powder just as dynamite is used. When TNT shots are fired, if the detonation is complete there will be produced large volumes of dense black smoke."

Traveling Mixer Plant Concretes Wall

A MIXER with incline hoist, and chute, mounted on a rolling platform, is building concrete retaining wall at Columbus, Ohio. The platform wheel gage is wide

MIXER AND INCLINE HOIST ON WHEELED PLATFORM

enough to straddle the footing trench which has been excavated ahead. Following the traveling mixer is a gantry which shifts the wall form. The procession of operations is indicated by the diagram. About 700 ft. of wall is being built ranging from 32 ft. to 17 ft. high with footing, but most of it is of the lesser depth. For



PROCESSION OF OPERATIONS CONSTRUCTING RETAINING WALL

the shallower wall the footing trench is not deep and it is being dug by a wide scraper, A, hauled by cable from hoisting engine B, up an incline to a platform trap C, and then dumped into wagons. The mixing plant is charged by wheelbarrows from trench side stock piles, but all other operations into the forms are mechanical. The wall forms are wood and are carried ahead, without being knocked down, by a gantry crane which straddles the wall. Hickey Bros., St. Louis, Mo., are the contractors for this work.

Dragline Excavator Lowers Water Main

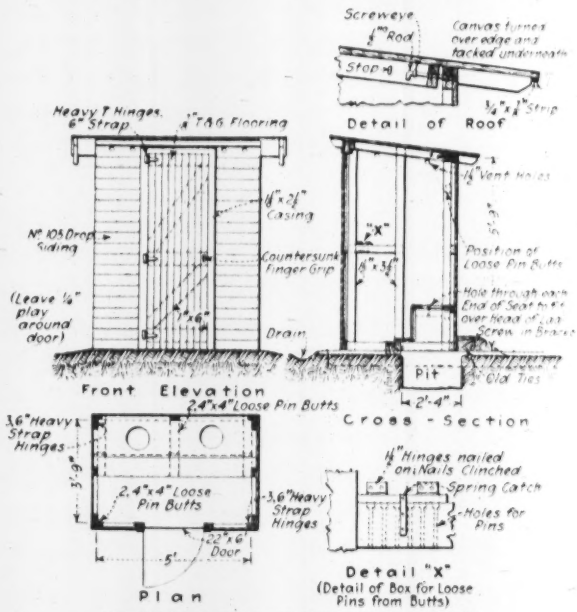
WATER mains crossing the Miami River at Dayton, Ohio, have been successfully uncovered and lowered by the 200-ton dragline excavators which are deepening and widening the channel for flood protection. The view shows one of these operations in progress. The excavator opens a pit, removing the overlying earth to within about 2 ft. of the pipe, and then digs deeper on each side. The earth is piled to form a cofferdam which is unwatered by one of the portable electric pumping outfits described in *Engineering News-Record* of Mar. 6, 1919, p. 490.

Men with shovels complete the uncovering of the pipe, and it is then separated into one or more sections by melting out the proper joints with an acetylene torch. The sections are moved to one side and the dragline excavates the new and deeper trench for the relocated main. Several crossing mains have been successfully lowered in this manner. The river improvement at Dayton, Ohio, is a part of the flood-control construction work in the Miami Conservancy district. Arthur E. Morgan is chief engineer, Charles H. Paul is assistant chief engineer, and C. H. Locher is construction manager.

DRAGLINE EXCAVATOR LOWERS WATER MAIN CROSSING THE MIAMI RIVER

Folding Portable Dry Closet

A STANDARD design of dry closet, with folding portable building, designed for temporary use by bridge gangs, etc., on the Nashville, Chattanooga & St. Louis R.R., and adapted also for use at construction camps, is shown in the accompanying cut. One end is hinged to the back and the other to the front, so that the building can be folded up for transportation. Three heavy 6-in. strap hinges are used at each of these corners. The other two corners are each fitted with two 4 x 4-in. loose pin butts for holding the building together when it has been assembled, a box being provided for holding the pins when the building is dismantled.



PORTABLE DRY CLOSET FOR CAMPS

The drip board is provided with two pieces of No. 27 galvanized iron, 12 x 19 in., centered on holes at the front of the seat. The foot board, drip board and seat are connected by 5-in. strap hinges so that these three parts can be folded together.

For the roof, the plank sheathing receives a coat of white lead and linseed oil, and while this is wet it is covered with heavy roofing canvas secured by flat-head copper tacks. Two coats of white lead and oil are then applied. Screws and cement-coated nails are used in the building, which gets two coats of paint inside and outside. The design was prepared under the direction of Hunter McDonald, chief engineer.

NEWS OF THE WEEK

New York, July 17, 1919

Bill for Illinois Deep Waterway Is Signed

The bill for a deep waterway connecting the Chicago Drainage Canal with the Illinois River, thus linking the Great Lakes and the Mississippi, has been signed by the Governor of Illinois, together with a bill authorizing a bond issue of $20,000,000 for this purpose, as already approved by public vote.

The project must be submitted to the War Department for approval. From the water-power plant of the Sanitary District of Chicago, at Lockport, the end of the Drainage Canal, the route will follow the tailrace, the Des Plaines River and the Illinois & Michigan Canal through Joliet, and then the Des Plaines River and Illinois River to a point on the latter near Utica, Ill. If the utilization of the two rivers is not considered practicable, the route may be changed to the Illinois & Michigan Canal or to new channels outside of the rivers. A bottom width of not less than 150 ft. is specified, with a depth of not less than 8 ft. in earth and 10 ft. in rock. For the locks, minimum dimensions of 110 x 600 ft. are specified, with 14 ft. of water on the miter sills. Through Joliet the water level is to be not higher than 40.5 ft. below Chicago datum, or 41 ft. if certain shoals are deepened, while the width must not be less than 270 ft. Through Ottawa, the level must be not higher than 120.5 ft. below Chicago datum.

Sewer connections must be built for these cities, and all dams must provide for quick disposal of flood waters. Provision is made for the lease of surplus water or water power. The construction, maintenance and operation of the waterway and its appurtenances are in the hands of the State Department of Public Works and Buildings, which may let contracts or carry out the work with its own forces.

Rapid Transit Engineers Vote in Favor of Unionization

At a special meeting of the Rapid Transit Engineers' Association of New York City, held July 14, to decide whether the association should affiliate with the American Federation of Labor, it was voted as the sense of the meeting that the members should join the Union of Technical Men as individuals. This action was taken when it was found that the association could not be accepted as a body, because the Union of Technical Men already existed in the district as an affiliate of the American Federation of Labor.

There were present about 200 of the 700 members of the association, which was organized the first of the year and is making a strong effort to get a fair increase in salaries for engineers of the Public Service Commission. The president of the association, R. A. Fiefel, presided; the meeting was also addressed by Kay B. Knudsen, secretary of the New York Chapter of the American Association of Engineers, who presented a plea for affiliation with that association.

The vote in favor of unionization was practically unanimous; the argument which swung this vote seemed to be that the unions, through the weight of thorough organization, had the power to enforce their demands.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 233 Broadway, New York City.

Chicago to Vote on $28,000,000 Bonds for Improvements

Chicago will submit to public vote in November several bond issues for public improvements, as follows: Widening and extending Robey St., $9,200,000; Ashland Ave. improvement, $5,400,000; extension of Ogden Ave. across the city, $5,400,000; reconstruction and double-decking of South Water St., $3,800,000; widening and extending Western Ave., $2,400,000; completing the Michigan Ave. link, $2,000,000.

Sewer Tunnel Contract Again Abandoned

Charles A. Haskins, contractor for the outfall tunnel section of the Passaic Valley sewer, under the City of Bayonne and New York Bay, has notified the Passaic Valley Sewerage Commission that he has abandoned his contract, because of 40% increase of cost since he entered into the contract in 1916. His bid totaled about $1,900,000. The work was let to Haskins as a compressed-air job following abandonment by the O'Rourke Engineering Construction Co., which was working under a free-air contract. The commission has instructed W. M. Brown, chief engineer, to investigate and recommend whether the contract should be readvertised or the work completed by force account.

House Passes Water-Power Bill

The House of Representatives has passed the water-power bill in substantially the same form as that passed by the House of Representatives at the last session of Congress. The measure is now before the Commerce Committee of the Senate, and will be taken up by a subcommittee of that body shortly after Aug. 1.

Friends of water-power legislation in Washington predict the early passage of the bill by the Senate, but in legislative circles at the capitol it is well understood that the question of foreign affairs relating to the peace treaty and the League of Nations will have an important effect upon the early passage of any legislation.

Patent Hearings in Progress Before House Committee

Public hearings on three bills relating to reorganization of the Patent Office are now being held by a House committee in Washington. Judge Learned Hand, of New York, pointed out the need for a single court of patent appeals, and emphasized the necessity for an increased force and better facilities in the Patent Office. The consensus of opinion of the inventors who have appeared before the committee seems to indicate that there is great need of an easier means of determining money recovery in case a patent has been infringed. One inventor asserted that if the salaries of Patent Office employees were made five times as large it would be an economy to the country, because the time of courts would be freed and inventors would not be distracted by the inadequacy of the Patent Office equipment.

Large Bond Issue Approved by Pittsburgh

By vote of the people, July 8, Pittsburgh approved a bond issue of $22,000,000 for permanent improvements. The largest item in the list is a $6,000,000 street-car subway in the downtown district. Another is Monongahela Boulevard, a roadway along the north bank of the Monongahela River from Grant St. and Second Ave. east to Craft Ave., to cost about $2,000,000. Widening Second Ave. between Liberty Ave. and Grant St. from 50 ft. to 80 ft. is included at $1,410,000. Nearly $1,500,000 is to be spent on improvement of the water system, including $490,000 for machinery in five pumping stations, $87,000 for renewals at the filtration plant, $90,000 for relining the Herron Hill reservoir, $400,000 for meter extensions, and $319,000 for pipeline extensions. Minor items in the list are $120,000 for six public comfort stations, and $600,000 for acquiring park lands in Sawmill Run Valley and at other points, and for park development.

The proposed street-car subway was described in *Engineering News-Record* of May 29, 1919, p. 1059, where a map of the subway location was shown.

Geological Survey Creates Division of West Indian Surveys

The United States Geological Survey is about to supervise extensive topographic mapping in the West Indies. The Republics of Santo Domingo and Haiti have made appropriations sufficient to complete the surveys of their countries and have requested the Geological Survey to take charge of the work and to furnish the technical personnel. It is probable that Porto Rico and the Republic of Cuba will take similar action. In order to provide for this work the Division of West Indian Surveys is created in the Topographic Branch. The chief of the Division will handle directly all matters pertaining thereto, except those which affect the general policy of the Geological Survey or of the Topographic Branch. Lieut. Col. Glenn S. Smith is relieved from his duties in connection with military surveys and is designated as topographic engineer in charge of the Division of West Indian Surveys.

Unusual War Service Record

In announcing the return of his son, Capt. Merlin L. Dappert of the 130th Infantry, 33rd (Prairie) Division, who was in the Army of Occupation at Luxembourg after participation in the Somme and the Meuse-Argonne offensives, J. W. Dappert, president of the Illinois Society of Engineers, also gives as follows, in the war-service record of the other members of the family associated with him in his office at Taylorville, Ill. One son, Lieut. J. Ivan Dappert, was killed in action near Albert, France; Lieut. John V. Dappert is now in the Fort Sheridan hospital, Chicago, under treatment for his eyes as a result of severe gassing; Lieut. Anselmo F. Dappert, of the Heavy Tank Corps, landed in New York, July 5; Sergeant Boyd H. Dappert, of the 306th Engineers, is still in France; Lucy C. Dappert was in Government service in Washington.

Hurley Retires as Chairman of Shipping Board

Edward N. Hurley, chairman of the United States Shipping Board, has tendered his resignation to President Wilson, to take effect Aug. 1, and the President has accepted the resignation. Chairman Hurley has been in charge of the organization of the Shipping Board and the Emergency Fleet Corporation since the early stages of the war, and he resigns at the present time from a desire to leave public life and have more time for personal affairs.

Airship Completes Round Trip Across the Atlantic Ocean

Landing at Pulham, England, at 6.56 a.m., July 13, the British dirigible R-34 completed the first round-trip air voyage from England to the United States. The homeward trip required approximately 75 hours, the take-off at Mineola, Long Island, having been made at 11.59 p.m., July 9, but the homeward journey started after New York City was circled for about one hour.

On the trip to this country the R-34 covered 3200 nautical miles in 108 hours 12 min., or an average speed of 29½ knots. The return trip, although handicapped by the breaking of one of the engines, was made in much better time, averaging about 42½ knots.

Shipbuilding in United States Decreases 25 Per Cent

June production of the United States shipyards amounted to 118 vessels delivered, of 578,583 dead-weight tons (388,402 gross tons). This compares with 136 vessels of 768,025 dead-weight tons delivered in May, as recorded in *Engineering News-Record* of June 12, 1919, p. 1181. The reduction is chiefly in steel ships, of which only 70, totaling 414,283 dead-weight tons, were delivered in June as against 87, totaling 594,425 tons, in May.

As compared with June of last year, the month's deliveries represent an increase of 106%, the production a year ago being 280,400 dead-weight tons. Furthermore, the past month's work represented about twice the production of the United States for the entire year of 1916, the highest pre-war year, when 38 seagoing vessels of over 1500 dead-weight tons each were completed, a total tonnage of 285,555.

Launchings for June also showed a decrease from the May figure, the total being 98 hulls of 504,200 tons for June as compared with 137 hulls of 705,958 tons for May.

Canadian Government Railway Operation Shows Loss

In a report to the Canadian House of Commons at Ottawa, the Hon. J. D. Reid, Canadian minister of railways, gave the estimated earnings and expenses of the Canadian Government railways for the current year, indicating an anticipated loss, in connection with operation, of about $28,000,000. This, he stated, includes interest on the cost of the Canadian Northern, but not on the capital expenditures of the other Government railways.

Estimates of money that must be provided for the railways during the coming year were stated by Mr. Reid as follows:

Loss, as stated above, $28,000,000; construction, $11,121,000; equipment and rolling stock, $20,000,000; betterment, $21,421,000, making a total of $80,542,000. The following contracts had already been given out: Locomotives, $2,350,000; freight equipment, $8,650,000, and passenger equipment $4,450,000.

Highway Bond Issue for $20,000,000 Passed in Canada

Government aid to encourage the construction and improvement of highways to the extent of $20,000,000 was passed by the Canadian House of Commons July 2, received its third reading by the Senate July 4, and only awaits the formal assent of the Governor General to become law. The bill calls for appropriations of $20,000,000 during a period of five years. Of that sum, $80,000 is to be granted to each province each year, and the balance is to be allowed in proportion to the population of the respective provinces of the Dominion.

The bill provides that grants are to be made only in consideration of work actually done for the improvement of particular highways and in accordance with agreement between the Federal Government and the province concerned. These agreements shall set forth the cost, description and specifications of the proposed highway and the manner in which the work is to be supervised by the Federal and provincial officials. The aid to be given by the Federal Government is to be 40% of the actual and necessary cost of the construction, and the expenditures are to be made by tender and contract, unless for special reasons the Governments of the Dominion and the province concerned agree to a different method of procedure.

Daylight Saving Continued

An organized effort to repeal the daylight-saving act by means of a rider attached to the agricultural appropriation bill has been defeated by the veto of the entire bill by the President on account of the rider. An attempt to pass the bill over the veto failed in the House by 15 votes.

Contributions from Engineers, Architects and Constructors' Conference on National Public Works

M. O. LEIGHTON, Chairman

PUBLISHER'S NOTE: The space occupied under this caption is donated to serve as a means of frequent and intimate communication between the Engineers, Architects and Constructors' Conference on National Public Works, and the members of the profession. The contributor takes full authority for the statements made.

THE PUBLIC WORKS BILL

The Jones-Reavis bill introduced into Congress to create a national Department of Public Works, and sponsored by this organization, is receiving wide praise from the engineers, architects and constructors of the country. A few constructive criticisms and suggestions are being received, and the officers of this organization solicit many more. Copies of the bill have been widely distributed, but more are available and anyone who desires one may obtain it on application to conference headquarters.

Much is being said of late concerning the engineer as a citizen and the methods by which he may acquire "influence" in Governmental affairs. In response to suggestions made by delegates who attended the Chicago conference certain remarks made by the chairman of the conference during a discussion of campaign methods are here given:

It is very clear that the way to run a campaign of the kind we propose is to have an organization in Washington, and many others in every state. It frequently happens that local organizations are either dead or moribund. Here and there is a live one, but for the most part, when it comes to getting concerted action and the headquarters at Washington sounds an alarm or sends out for information and advice, it is a good deal like pouring water down a rat hole.

Now, talking very frankly about the call for this meeting, about 180 invitations were issued. We received declinations from ten or twelve, acceptances from about 80, and dead silence from all the remainder.

I don't suppose that there is one engineer in a hundred who realizes how poorly engineers are regarded in Washington so far as potentiality in political affairs is concerned. You don't stand as high as the undertakers, and when you are compared with trade unions you are so far behind that no one knows you exist.

Some of us remember when a committee of most distinguished engineers went to Washington to give advice to a Senate committee on an important engineering matter. You would have supposed that the cream of the engineering profession of the United States would have secured a respectful hearing. They barely got inside the door of the committee room. The Senate committee promptly adjourned. They wouldn't treat a plumbers' union like that, nor a committee from the American Bar Association, nor yet a conclave of Presbyterian ministers. They have fallen into the habit of discounting engineers. The facts are, you don't count at all, and it is simply and solely the result of your indifference as illustrated by the response to the invitation of Engineering Council to come to this conference.

I realize that I am talking to the wrong people. Your societies came forward and you are here, but you are the exceptions that prove the rule. You can pick out the best committee in the engineering profession to take charge in Washington, but that committee isn't going to do you one bit of good unless you, here, represented at this conference, take the pains to dig out the dead societies and the moribund members and shake them up.

Why don't you authorize that Washington committee to spend a little money to dig out these engineering societies and get them to work? In other words, my friends, why don't you use the intelligence of a carpenters' union or a plumbers' union or the American Federation of Labor? Sometimes it seems as though you are temperamentally unfit for that kind of a job. Perhaps you are not, but believe me, gentlemen, you act as though you were. Influence means influx. That is what the engineers lack—influx. You don't flow into things. You stand on the outside looking in.

ORGANIZATION

The organization of the conference on public works has been completed by the appointment of a finance committee and a treasurer. The former consists of D. A. Garber, chairman; Francis Blossom, J. Parke Channing, Col. Peter Junkersfeld and W. H. Nichols, Jr. The treasurer is Milton E. Ailes, vice-president of the Riggs National Bank, Washington, D. C.

The following is a list of the chairmen of the state campaign committees, appointed to date, which will conduct the campaign of education within their respective jurisdictions. Organizations in states not here mentioned are in process of formation.

States	*Chairmen*	*Addresses*
Arizona	Col. Epes Randolph	Tucson
Arkansas	Charles H. Miller	Little Rock
California	C. E. Grunsky	San Francisco
Colorado	Richard A. Parker	Denver
Florida	G. R. Benton	Gainesville
Georgia	Earl F. Scott	Atlanta
Idaho	A. J. Wiley	Boise
Illinois	W. L. Abbott	Chicago
Indiana	H. O. Garman	Indianapolis
Iowa	J. H. Dunlap	Iowa City
Kansas	Lloyd B. Smith	Topeka
Louisiana	Major W. B. Gregory	New Orleans
Maryland	J. E. Greiner	Baltimore
*Massachusetts	George F. Swain	Cambridge
Michigan	Gardner S. Williams	Ann Arbor
Minnesota	W. H. Hoyt	Duluth
Mississippi	W. L. Thompson	Greenville
Missouri (Eastern)	Baxter L. Brown	St. Louis
Missouri (Western)	J. Lyle Harrington	Kansas City
Montana	M. H. Gerry	Helena
Nebraska	G. E. Condra	Lincoln
Nevada	J. G. Scrugham	Carson City
New York (Eastern)	George W. Fuller	New York
New York	Wm. B. Powell	Buffalo
North Carolina	Col. J. H. Pratt	Chapel Hill
North Dakota	E. F. Chandler	University
Ohio	E. G. Bradbury	Columbus
Oklahoma	Max L. Cunningham	Oklahoma City
Pennsylvania (Eastern)		
Pennsylvania (Western)	Morris Knowles	Pittsburgh
South Carolina	S. B. Earle	Clemson College
South Dakota	Homer W. Doerr	Pierre
Texas	T. U. Taylor	Austin
Utah	R. C. Gemmel	Salt Lake City
Virginia	Thomas L. Watson	Charlottesville
West Virginia	Mayo Tolman	Charleston
Wisconsin	F. A. Vaughn	Milwaukee

*And all New England.

French House Rebuilding Let to Canadian Architect

Georges Vannier, a Canadian architect, has announced that he has a contract for rebuilding 2000 houses at Soissons, France, and for a number of other buildings in many of the neighboring towns and villages. He has offices at 15 Rue de Miromesnil, Paris, and is in the market mainly for concrete reinforcement.

Federal Aid During June

During June the Department of Agriculture, through the Bureau of Public Roads, approved Federal-aid project statements to the number of 133, involving the improvement of 1390 miles of road, at an estimated cost of $24,220,000. The Federal aid on the above will be $11,034,000. This was a record over every previous month. Project agreements to the number of 60 were also executed, involving 507 miles, at an estimated cost of $7,566,000 and Federal aid of $3,404,000.

The total mileage and amounts involved to date in the various classifications are: (1) Approved project statements, 1319; mileage, 12,790; estimated cost, $133,833,000; (2) project agreements executed, 677, involving 5776 miles; estimated cost, $56,367,000. Federal aid amounts to considerably less than half the total.

Civil Service Examinations

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Valuation aid, $1200 to $1500 per year; valuation engineer, $3600-$4800 per year, and assistant valuation engineer, $2500-$3600 per year; technical staff, income-tax unit, Bureau of Internal Revenue, Treasury Department. No date specified.

Master computer, $2400 to $1800 per year, computer (Grade I) $1800 to $1400 and computer (Grade II) $1400 to $900, Ordnance Department. Applications will be received until further notice.

Electrical assistant, signal service at large, War Department, for duty at Manila, Philippine Islands, $1500 to $2000 per year. Applications must be filed before the close of business on Aug. 19.

Technical assistant, field of civil engineering, $3200 per year, and technical assistant, torpedo design, $3000 per year. Applications must be filed by Aug. 19.

Supervising draftsman, bureau of steam engineering, Navy Department, $12.80 to $13.60 per diem. Applications must be filed before August 19.

Chief ship draftsman, U. S. Navy Department, $10 to $12 per diem;

draftsman, grade A, $8 to $9.60 per diem; draftsman, grade B, $6 to $7.20 per diem; draftsman, grade C, $5.20 per diem. No date specified. Applications should be filed without delay.

Chief draftsman, general engineering, architectural, power plant, heating and ventilating, electrical, U. S. Navy Department, $10 to $12 per diem; draftsman, grade B, $6 to $7.20 per diem; draftsman, grade C, $5.20 per diem. No date specified. Applications should be filed without delay.

ENGINEERING SOCIETIES

Calendar

Annual Meeting

NEW ENGLAND WATER WORKS ASSOCIATION; Tremont Temple, Boston; Sept. 30, Oct. 1-3, Albany, N. Y.

The South Carolina Association of Civil Engineers was formed at Columbia, July 8. There were 75 engineers present who took part in the organization. The following officers were elected: President, J. E. Sirrine, of Greenville; first vice-president, G. E. Spand, of Columbia; second vice-president, W. L. Lee, of Sumter; secretary and treasurer, John McCrady of Charleston.

The Chattanooga Chapter of the American Association of Engineers held a regular meeting July 2, at which the following permanent officers were elected: President, H. C. Sherer; vice-president, H. D. Scantlin; secretary, Ray Dunlap; treasurer, J. L. Fergus, and member-at-large, R. C. Morrison. Discussions at the meeting centered on the Gronna bill, the National Highway Council, and the subject of the abolishment of the Department of the Interior. Special committees were appointed to investigate and recommend what action the chapter should take regarding these bills.

PERSONAL NOTES

FRANK C. EMERSON has been appointed state engineer of Wyoming. For the past 15 years Mr. Emerson has been in charge of large irrigation enterprises in that state. At the time of becoming state engineer, in addition to a general consulting practice, he was superintendent of the Big Horn Canal Association and the Lower Hanover Canal Association, with headquarters at Worland, Wyo.

GEORGE M. SCHWAB, during the war purchasing agent at Camp Pike, Arkansas, has been made chief engineer of the Wolverine Brass Works, at Grand Rapids, Mich.

CAPT. HERBERT SPENCER, of the 23rd Engineers, American Expeditionary Forces, has received his discharge from the service, and has resumed his position with the Standard Oil Co. While in France he was engaged largely in highway work.

H. M. STOFFLET, formerly superintendent of construction for the Austin Co. at Indian Head, Md., has been transferred to the Philadelphia division in charge of the construction work on the Liggett & Myers Tobacco Company's building.

JOHN D. MOHLER, assistant city engineer, St. Joseph, Mo., has resigned to accept the position of special highway engineer, in charge of road construction, Buchanan County, with headquarters at St. Joseph, Mo. The county recently voted $2,000,000 in bonds for hard-surface roads.

HANS VON UNWERTH and J. C. BYRD, consulting structural engineers, have formed a partnership, using the firm name of VON UNWERTH & BYRD, with offices at 505 Finance Bldg., Kansas City, Mo. Mr. Byrd has just returned from overseas service as captain with the 314th Engineers.

RUDOLPH P. MILLER, formerly superintendent of buildings for Manhattan and chairman of the board of standards and appeals, and GEORGE E. STREHAN, formerly assistant engineer in the bureau of buildings and the board of standards and appeals, have become associated in the general practice of engineering, with offices at 112 W. 42nd St., New York City.

WALTER W. MCGUIRE, recently with the St. Louis Water Division, has resigned to become associated with the du Pont Engineering Co. on the construction of the General Motors Corporation's new plant at Union and Natural Bridge Roads, St. Louis.

CHARLES S. LEMON, a division engineer of the Pennsylvania State Highway Department, has been appointed engineer for the Bureau of Township Highways.

H. R. MOFFITT, formerly assistant engineer of the Pennsylvania State Highway Department, has been appointed to succeed CHARLES S. LEMON, whose transfer is noted above, as engineer of the Blair-Cambria-Somerset-Bedford district.

LIEUT. ROBERT J. H. WORCESTER, having received his discharge from the Army, has returned to his former position as engineer and superintendent of roads and bridges for the town of Concord, Mass. Lieutenant Worcester served with the 42nd (Rainbow) Divisional Engineers at St. Mihiel, in the Argonne and in the Army of Occupation.

P. J. DAVIS and F. M. KUCHAR, assistant construction superintendent and principal assistant engineer, respectively, with the J. G. WHITE ENGINEERING CORPORATION on the construction of the 60,000-kw. steam power plant at the United States Nitrate Plant No. 2, Muscle Shoals, Alabama, have resigned to form the DAVIS-KUCHAR CO., with offices at Miami, Fla. They will engage in general contracting and consulting engineering.

LIEUT. COL. EDWIN VAN RENSSELAER PAYNE, 25th Engineers, U. S. A., has received his discharge from the service and has returned to his work with the department of the State Engineer and Surveyor of New York. His present location is the New York City office in the Hall of Records.

J. H. SAWKINS, formerly instructor in drawing and descriptive geometry, department of civil engineering, Union College, Schenectady, N. Y., has resigned to accept the position of designing engineer in the department of grounds and buildings of the General Electric Co. of that city.

M. B. BAIR, who formerly was principal assistant engineer of the division of sanitary engineering, Ohio State Department of Health, has been appointed chief engineer of the bureau of sanitation of the Arkansas State Board of Health, with offices in the state capitol at Little Rock.

J. C. WALTON, a member of the MACKINTOSH-WALTON CO., consulting enegineers, has been elected mayor of Oklahoma City, Okla. Previous to his election he was commissioner of public works and handled the problems of straightening the North Canadian River through the city, eliminating grade crossings and developing an intercepting-sewer system and sewage-disposal plant.

CAPT. W. V. BUCK, of the 23rd Engineers, U. S. A., has been appointed assistant state highway engineer of Kansas. Before entering the service Mr. Buck was in charge of the construction work of A. Jaicks Co., general paving contractors, Kansas City, Mo

MAJ. CARL A. HEINZE, assistant engineer in charge of distribution and maintenance in the bureau of power and light, Los Angeles, Calif., has returned to duty in the department after more than two years' military service. He has been identified with the aqueduct and power development work from its inception.

CAPT. EDGAR L. TENNEY, 108th Engineers, U. S. A., has received his discharge and has taken up practice as consulting engineer for bridge, building and foundation work, with office at 1642 Monadnock Block, Chicago.

FRANK S. EASTON, hydro-electric engineer with the British Columbia Electric Railway Co., of Vancouver, B. C., has resigned to enter the employ of the Mexican Light & Power Co., with headquarters in Mexico City. Mr. Easton will have charge of certain hydraulic and electrical work for the company, under the direction of G. R.

G. CONWAY, managing director, who was formerly chief engineer of the British Columbia Electric Railway Company.

MAJ. EDWARD BARTOW has returned from his service in France with the sanitary corps of the American Expeditionary Forces and will resume his position as chief of the Illinois State Water-Survey Division, with offices at Urbana, Ill.

F. J. VON ZUBEN, city engineer of Fort Worth, Texas, since 1905, has resigned to engage in private business.

FRANK F. FOWLE and JAMES R. CRAVATH have formed a partnership for the practice of electrical, illuminating and mechanical engineering, under the firm name of FOWLE & CRAVATH, with offices at 1201 Monadnock Block, Chicago. Both were formerly consulting engineers of that city.

LIEUT. COL. H. L. TROTTER, D. S. O., lately in command of the 11th Battalion, Civil Engineers, has become a partner in the firm of HENRY HOLGATE, consulting engineer, Montreal, Que.

H. B. PEARSON, JR., formerly with the Alan-Wood Iron & Steel Co., of Swedeland, Penn., has left that company to become resident engineer of the Breaker Island project of the Connellsville Coal & Coke Byproducts Co., Albany, N. Y.

ALFRED MCKEEL has resigned his position as assistant engineer to the North Dakota State Highway Commission to become highway engineer under F. O. LANG, county engineer of Polk County, at Des Moines, Iowa.

D. L. LEWIS, formerly building inspector of Fort Worth, Texas, has been elected city engineer to succeed F. J. VON ZUBEN, whose resignation is noted elsewhere.

Weekly Bulletin Issued by Bridgeport District Salvage Board

The Bridgeport District Salvage Board, Ordnance Department, U. S. A., is issuing a weekly bulletin containing a list of all Government property within the Bridgeport district available for sale. This property comprises buildings, building equipment, power equipment, factory supplies, tools, machinery, etc. The bulletin will be mailed weekly to any one applying to the board at 945 Main St., Bridgeport, Conn.

Trade Resumed with Germany and Some Other Countries

Resumption of commercial relations between the United States and Germany, effective July 15, has been authorized by our Federal authorities. Reservations have been made against the importation of dyes, potash, drugs, chemicals and wheat, and the export of wheat will remain under control of the Grain Corporation. Operations under the control of the Alien Property Custodian are not affected by the orders. The trading with the enemy act remains in force, technically, but by means of blanket licenses it will be suspended on application. The same system applies to other countries which have been under the ban, except Hungary and parts of Russia. The blanket licenses are issued by the war trade board section of the Department of State, Washington, D. C., to which application may also be made for various exceptions and restrictions. Mail, cable and money exchange with Germany was also resumed July 15.

Small Motor Truck May Have Dump or Fixed Body

The three-wheel motor truck with 1-yd. dump body shown in the accompanying views is intended for use in hauling concrete, concrete materials and excavated materials on construction work, as well as for handling rock in quarries and mines and delivering coal and other supplies at industrial plants. The machine may have a fixed platform or box body for carrying packages and freight at manufacturing plants and warehouses and has a drawbar connection for use as a tractor.

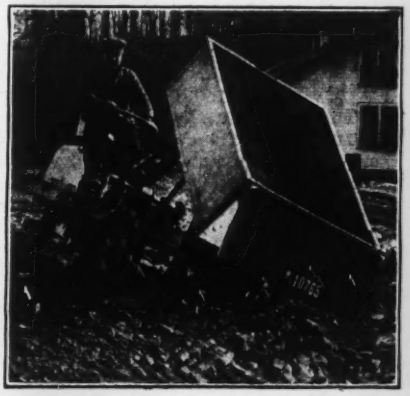
GAS TRACTOR WITH AUTOMATIC DUMP BODY

Being strongly built and gas driven, a wide range of usefulness is claimed for the new truck. It is not considered, exactly, a competitor of the electrical tractors ordinarily used around industrial plants, for although it is applicable for such use, it has sufficient and uniformly constant power for travel on country highways and over steep grades for long distances.

In operating the truck, the driver sits at the rear, so that he has a good view of the body while dumping. As equipped with a dump body the truck weighs 2450 lb., and has overall dimensions of 46 x 125 in., with a wheelbase and turning radius of 7 ft. Its carrying capacity is 1½ tons. The steering is done by the single trailer wheel.

Two types of dump body are shown, one of which is automatic, being released by the operator and dumped by the chain and spring at the forward end, the other, which is seen operating on country road grading, has to be unlatched at the dumping end before tipping.

Power is furnished by a four-cylinder 25-hp. gasoline engine, and is applied to the front wheels through an internal gear-drive axle. Metal disk-wheels are used, with wide steel flanges or rubber tires. This machine is built by the Clark Tructractor Co., 80 East Jackson St., Chicago, and is sold by the Liberty Steel Products Co., Inc., Woolworth Building, New York City.



GAS TRACTOR ON ROAD GRADING

Coöperative Publicity Work

The Manufacturers' Publicity Bureau, of 140 So. Dearborn St., Chicago, is now issuing a monthly publication entitled *Successful Methods—a Magazine of Construction Service*. It is intended for contractors, engineers and others engaged in all sorts of construction work as well as in mining, quarrying, clay working, and cement production, and may be had free on application. The July issue contains articles on road and other construction work, general contracting, aids to manufacturers in selecting machinery best suited to the work in hand, and miscellaneous articles.

Material-Handling Machinery and Factory Appliance Exchange

An international material-handling machinery and factory appliance exchange has been organized by the Merchants and Manufacturers' Exchange of New York, in connection with the taking over of the Grand Central Palace for the purpose of turning it into a mammoth trade clearing house. This will be one of the eight permanent industrial expositions

which will fill eight floors of the large structure. The remainder of the building will be used for short-time expositions of various kinds. C. R. Ringenberg, formerly of the Material Handling Machinery Manufacturers' Association, is secretary and manager of the new exchange, with offices at 405 Lexington Ave., New York City. Fred W. Payne is general manager of the Merchants and Manufacturers' Exchange, and will have supervision of all the expositions in the building.

National Highway System Booklet

An attractive illustrated booklet, entitled "The National Highway System," has just been issued by the American Automobile Association. Among the subjects dealt with are: The basic reason for a national highway system; motor traffic a dominant highway influence of today; Federal highway supervision vs. Federal inspection, with many other chapters of less length on various subjects. The booklet should be of value to all those who are interested in the promotion of a national highway commission and a national system of roads.

BUSINESS NOTES

THE READING VALVE AND FITTINGS CO., of Reading, Penn., has just completed a $250,000 addition to its plant, including increased foundry facilities and modern machine shop for manufacturing flanged and screwed fittings and flanges of both iron and steel.

THE CORRUGATED BAR CO., INC., of New York, has taken over the entire assets and liabilities of the Corrugated Bar Co., a Missouri corporation, and is continuing the business of the latter company. Control of the company now passes to A. L. Johnson, who has been connected with it since July, 1895.

THE BLAW-KNOX CO. has opened offices in the Little Bldg., corner of Boylston and Tremont Sts., Boston, Mass., and in the Owen Bldg., Detroit, Mich. A. W. Ransome, formerly of the New York office, assumes the duties of New England manager, and H. J. Desson has been transferred from the Pittsburgh office to Detroit to assume the duties of manager of the Michigan district.

THE MASSEY CONCRETE PRODUCTS CORPORATION, of the People's Gas Bldg., Chicago, has made the following appointments: Paul Kircher, resident manager of the Eastern district, including Eastern Canada, with headquarters at 50 Church St., New York; G. H. Redding, resident manager in charge of sales in the Central district, with headquarters in Chicago; H. E. Burns, resident manager in charge of sales in the Southwestern district, with headquarters in the Sumpter Bldg., Dallas, Tex.

THE MAHER ENGINEERING CO. has been organized at Chicago, with offices in the Michigan Boulevard Building, to handle the sales and installation of pumps, engines and machinery for fertilizer and sulphuric acid.

THE MIDWEST ENGINE CO., of Indianapolis, has opened offices at four new locations with the following representatives: D. J. Carrison, Florida Life Bldg., Jacksonville, Fla.; Chester B. Loomis, Southwestern representative, 303 Caples Bldg., El Paso, Tex.; B. H. Downing, Eastern sales manager, 111 Broadway, New York City, and J. R. Lowe, Southern representative, 617 Maison Blanche Bldg., New Orleans, La.

THE EDISON PORTLAND CEMENT CO., of New Jersey, has a new representative in New York City, W. D. Cloos, with office at 8 W. 40th Street.

THE HOLT MANUFACTURING CO., of Peoria, Ill., has appointed E. A. White, formerly head of the division of agricultural engineering, University of Illinois, as chief of the company's research division. Fred W. Jones has been appointed advertising manager; he goes to the Holt company from the advertising department of the International Harvester Co. of America.

THE AMERICAN STEAM CONVEYOR CORPORATION, engineers and contractors, 326 W. Madison St., Chicago, Ill., announces that S. F. Joor, a consulting engineer of Chicago, has joined its organization as sales engineer. At one time Mr. Joor was Western manager and sales engineer of the Jeffrey Manufacturing Company.

THE CARR MACHINERY CO. has been organized by C. H. Carr, with offices at 615 Reliance Bldg., Kansas City, Mo. The new firm sells the lines manufactured by the Ferry Steam Turbine Co. and the Alphons Custodis Machinery Co. Mr. Carr was formerly with the Allis-Chalmers Co. in the Kansas City office.

THE ABERTHAW CONSTRUCTION CO., of Boston, Mass., has opened a permanent office in Atlanta, Ga.; it will be under the direction of H. McL. Sage.

THE CHICAGO PNEUMATIC TOOL CO., of the Fisher Bldg., Chicago, has appointed L. C. Sprague, formerly district manager of sales at New York, as manager of Western railroad sales, with headquarters in the Fisher Bldg., Chicago. H. G. Barbee has been appointed manager of Eastern railroad sales, with headquarters at 52 Vanderbilt Ave., New York City, and Nelson B. Gatch, formerly assistant manager of sales at Chicago, is now district manager of sales at New York, succeeding Mr. Sprague.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE GENERAL FIREPROOFING CO., of Youngstown, Ohio; folder, 6¼ x 9¼ in., 12 pages, illustrated; describes method of fireproofing walls.

THE CARBO-HYDROGEN CO. OF AMERICA, of the Benedum-Trees Bldg., Pittsburgh, Penn.; catalog, 6¼ x 9 in., 27 pages, illustrated; describes the use of Carbo-Hydrogen apparatus for cutting steel and wrought iron.

THE THEW AUTOMATIC SHOVEL CO., of Lorain, Ohio; bulletin, 8½ x 11 in., 19 pages, illustrated; industry bulletin No. 30; describes the operation of steam shovels upon highway construction.

THE DAYTON-DAWD CO., of Quincy, Ill.; bulletin No. 240, 7½ x 10½ in., 16 pages; describes design and gives information regarding the selection of centrifugal pumps.

THE MERCURY MANUFACTURING CO., of 4118 S. Halsted St., Chicago, Ill.; catalog, 6 x 9 in., 18 pages; subject "Trackless Train"; describes rubber-tired tractors and trailers in train.

THE ALLIS-CHALMERS MANUFACTURING CO., of Milwaukee, Wis.; bulletins Nos. 1096, 1105 and 1816, 8 x 10½ in., 8, 20 and 16 pages, respectively, illustrated; describe sanitary and portable air-compressor equipment, direct-current motors and generators and crushing rolls.

THE PORTABLE MACHINERY CO., of Passaic, N. J.; folder, 8½ x 11 in., two pages, illustrated; refers to scoop conveyor infringement and warns against purchase.

THE AMERICAN MANGANESE BRONZE CO., of Holmesburg, Philadelphia, Penn.; catalog, 3¾ x 9 in., 24 pages, illustrated; gives information regarding manganese bronze valve stems.

THE BALDWIN LOCOMOTIVE WORKS, Philadelphia, Penn.; catalog, 9 x 6 in., 21 pages, illustrated; describes various types of locomotives, shells, ordnance and railway artillery used in the war.

THE SOUTHERN PINE ASSOCIATION, of New Orleans, La.; folder, 8½ x 11 in., 2 pages, illustrated; shows the various kinds of signs advocated by the association for the prevention of accidents in mills.

THE GEORGE C. VIDETTO MACHINERY CO., Pittsburgh, Penn., was printed Zidetto in last week's issue by mistake.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor — Charles Whiting Baker, Consulting Editor

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An Aërial Disaster

STRUCTURAL engineering resources provide no reasonable means of protecting city buildings from the impact of a falling airship. Such a disaster as occurred in Chicago three days ago, when the car of a flaming dirigible plunged through the skylight of a downtown bank, will remain one of those rare happenings from which little is to learned toward safeguarding the future. Other great Chicago disasters of recent years—the Iroquois Theater holocaust or the capsizing of the "Eastland"—were at least in minute measure redeemed by the resulting progress toward greater public safety. In the present disaster there is no such redeeming consideration, unless it be the lesson that aërial "joy-riding" must be placed under closer surveillance.

Box-Car Shortage Due

IN A few weeks the movement of the largest wheat crop on record will be under way. No one can say just where the movement will be greatest or where the millions of bushels will be stored, but the grain is here and the Government must buy it. At any rate, for some months all of the box cars that can possibly be found will be directed to the wheat traffic. Those concerned with the purchase or sale of commodities using box cars will do well to note this prospect and arrange their business accordingly. Box cars, like all other railroad equipment, have not increased normally in the past few years. When a congestion of demand meets a reduction in supply there is always trouble.

An Unjust Discrimination

EVER since the United States Public Health Service began publishing its directories of health officials in *Public Health Reports*, it has done an injustice to engineers and other technically trained men serving in the capacity indicated. Great care seems to be taken to put "M. D." after the name of every health officer entitled to it, but the engineers, chemists and bacteriologists in the service receive no credit for similar college degrees. To divide public health officials into two great classes—doctors and all others—is unjust discrimination against a large and growing number of highly trained men.

A Hexagonal Diagram

OCCASIONALLY something "new under the sun" emerges. This seems to be true of the ingenious hexagonal diagram for finding the velocity of water in pipes, contributed from beneath the South American sun by Mr. Anthony, and reproduced on p. 169 of this issue. As an example of the uses to which the diagram may be put Robert E. Horton suggests that it can be used to find "the relative capacity of pipes in accordance with the Barnes formulas, in which different exponents are used for each different class of pipe."

Continue the Engineer Training Camps

MILITARY engineering is not a stationary science. The war has proved that, as it has proved the importance of the fighting engineer. Everything in reason must be done to make the training of our future Army engineers as scientific and as resultful as possible. In doing this, no one thing could be of more value than the continuance of Camp A. A. Humphreys, on the Potomac below Washington, as a training camp both for officers and for troops. Economy in public expenditure is, of course, necessary now that war emergencies have passed, but parsimony is dangerous. Civilian engineers join the Corps of Engineers in its plea to Congress that sufficient funds be provided to continue the temporary construction of the camp, so that engineer soldiers can be trained there in the essentials of their business. In time, let us hope, the camp will be made permanent.

Hindering New York Harbor Development

NEW YORK CITY—or at least the administration which at present governs the city—continues to pursue its dog-in-the-manger policy in the development of New York harbor. Not very long ago it managed to put off for another year consideration of the proposals of the interstate harbor board for joint action by the States of New York and New Jersey. Now, through its Department of Docks, it comes forward with the so-called Hulbert plan of port development, which is nothing more than the continued construction of steamship piers, at first on Staten Island and later at scattered points around the city's 600-mile shore line, disregarding entirely the fact that extra provision for steamships will only further complicate the port problem unless some way is devised to take care of the goods coming from or going to these ships. This failure to recognize the elements of port design and management is not due to ignorance, but to the parochial viewpoint common to the politician. Those in charge of the city simply cannot get themselves to admit that New Jersey has any part whatsoever in the natural harbor at the mouth of the Hudson. Meanwhile, private interests are alive to the necessity which the official mind will not admit. Within the past month three separate schemes for elaborate port terminal construction on the lower New Jersey shore of the inner harbor have come to light. Each one envisages the port as a machine through which must move in two directions a large part of the world's business, and not as a mere landing place for steamships. All of these plans are advanced well along in design and each one has a considerable financial backing. It would be no surprising thing if the City of New York found the control of the harbor deliberately taken by the opposite state because the city officials could not see outside their polling places.